

# **Indian, Tabbs, Dymer, and Antipoison Creeks Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Pollution**

**Virginia Department of Environmental Quality**

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**Table of Contents**

<b>Executive Summary</b>	<b>vii</b>
<b>1.0 Introduction</b>	<b>1</b>
<b>1.1 Overview of the TMDL Process</b>	<b>2</b>
<b>2.0 Designated Uses and Applicable Water Quality Standards</b>	<b>2</b>
<b>2.1 Designated Uses and Criteria</b>	<b>3</b>
<b>2.2 Classification of Virginia's Shellfish Growing Areas</b>	<b>3</b>
<b>3.0 Watershed Characterization</b>	<b>4</b>
<b>3.1 Geology and Soils</b>	<b>9</b>
<b>4.0 Water Quality Impairment and Bacterial Source Assessment</b>	<b>11</b>
<b>4.1 Water Quality Monitoring</b>	<b>11</b>
<b>4.2 Condemnation Areas</b>	<b>12</b>
<b>4.3 Fecal Coliform Bacterial Source Assessment</b>	<b>12</b>
<b>A. Point Source</b>	<b>12</b>
<b>B. Non Point Source</b>	<b>14</b>
<b>4.4 Bacterial Source Tracking</b>	<b>32</b>
<b>5.0 TMDL Development</b>	<b>40</b>
<b>5.1 The TMDL Calculation</b>	<b>40</b>
<b>A. Current Fecal Coliform Condition</b>	<b>40</b>
<b>B. Geometric mean Analysis</b>	<b>40</b>
<b>C. 90<sup>th</sup> Percentile Analysis</b>	<b>42</b>
<b>D. Recreational Impairment Analysis</b>	<b>44</b>
<b>5.2 Load Allocation</b>	<b>45</b>
<b>A. Development of Waste Load Allocation</b>	<b>49</b>
<b>5.3 Consideration of Critical Conditions and Seasonal Variations</b>	<b>50</b>
<b>5.4 Margin of safety</b>	<b>50</b>
<b>5.5 TMDL Summary</b>	<b>50</b>
<b>6.0 Implementation</b>	<b>53</b>
<b>6.1 Staged Implementation</b>	<b>54</b>
<b>6.2 Link to ongoing Restoration Efforts</b>	<b>55</b>
<b>6.3 Reasonable Assurance for Implementation</b>	<b>55</b>
<b>A. Follow up Monitoring</b>	<b>55</b>
<b>B. Regulatory Framework</b>	<b>55</b>
<b>C. Implementation Funding Sources</b>	<b>56</b>
<b>D. Addressing Wildlife Contributions</b>	<b>56</b>
<b>7.0 Public Participation</b>	<b>57</b>
<b>8.0 Glossary of Terms</b>	<b>58</b>
<b>9.0 Citations</b>	<b>61</b>

## Table of Contents

	<u>Page</u>
<b>10.0 Appendices</b>	<b>62</b>
<b>Appendix A Growing Area 16 and 17 Shoreline Sanitary Surveys and Condemnation Notices</b>	<b>63</b>
<b>Appendix B Supporting Documentation and Watershed Assessment</b>	<b>150</b>
<b>A. GIS Data and Description Process</b>	<b>154</b>
<b>B. Population Numbers</b>	<b>155</b>
<b>C. Watershed Source Assessment</b>	<b>158</b>
<b>Appendix C Water Quality Data</b>	<b>160</b>
<b>Appendix D 1) Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.</b>	<b>164</b>
<b>2) 33 CFR Volume 2, Parts 120 to 199. Revised as of July 1, 2000</b>	<b>164</b>
<b>Appendix E Public Comments</b>	<b>178</b>

## List of Figures and Tables

<u>List of Figures</u>		<u>Page</u>
Figure 3.0	Indian, Dymer, Tabbs, and Antipoison Creeks Topographic Map	5
Figure 3.1	Indian, Dymer, Tabbs, and Antipoison Creeks Land Use Map	6
Figure 3.2	Indian Creek Land Use Percentages	7
Figure 3.3	Dymer Creek Land Use Percentages	8
Figure 3.4	Tabbs Creek Land Use Percentages	8
Figure 3.5	Antipoison Creek Land Use Percentages	9
Figure 3.6	Indian, Dymer, Tabbs, and Antipoison Creeks Soils Map	11
Figure 4.1	Map of Water Monitoring Stations and Condemnations	16
Figure 4.2A	30 Month Geometric Mean for Indian Creek Mainstem	20
Figure 4.2B	90 <sup>th</sup> Percentile for Indian Creek Mainstem	20
Figure 4.3A	30 Month Geometric Mean for Indian Creek Mainstem, upstream	20
Figure 4.3B	90 <sup>th</sup> Percentile for Indian Creek Mainstem, upstream	20
Figure 4.4A	30 Month Geometric Mean for Barnes Creek	20
Figure 4.4B	90 <sup>th</sup> Percentile for Barnes Creek	20
Figure 4.5A	30 Month Geometric Mean for Henrys Creek Stations 24 and 25	21
Figure 4.5B	90 <sup>th</sup> Percentile for Henrys Creek Stations 24 and 25	21
Figure 4.6A	30 Month Geometric Mean for Henrys Creek Stations 25A and 25B	21
Figure 4.6B	90 <sup>th</sup> Percentile for Henrys Creek Stations 25A and 25B	21
Figure 4.7A	30 Month Geometric Mean for Bells Creek	21
Figure 4.7B	90 <sup>th</sup> Percentile for Bells Creek	21
Figure 4.8A	30 Month Geometric Mean for Long Creek	22
Figure 4.8B	90 <sup>th</sup> Percentile for Long Creek	22
Figure 4.9A	30 Month Geometric Mean for Pittmans Cove	22
Figure 4.9B	90 <sup>th</sup> Percentile for Pittmans Cove	22
Figure 4.10A	30 Month Geometric Mean for Waverly Cove	22
Figure 4.10B	90 <sup>th</sup> Percentile for Waverly Cove	22
Figure 4.11A	30 Month Geometric Mean for Dymer Creek Mainstem Station 17	23
Figure 4.11B	90 <sup>th</sup> Percentile for Dymer Creek Mainstem Station 17	23
Figure 4.12A	30 Month Geometric Mean for Arthur Cove	23
Figure 4.12B	90 <sup>th</sup> Percentile for Arthur Cove	23

Figure 4.13A	30 Month Geometric Mean for Dymer Creek Mainstem Station 19	23
Figure 4.13B	90 <sup>th</sup> Percentile for Dymer Creek Mainstem Station 19	23
Figure 4.14A	30 Month Geometric Mean for Dymer Creek Mainstem Stations 20 & 21	24
Figure 4.14B	90 <sup>th</sup> Percentile for Dymer Creek Mainstem Stations 20 & 21	24
Figure 4.15A	30 Month Geometric Mean for Dymer Creek Mainstem Station 21A	24
Figure 4.15B	90 <sup>th</sup> Percentile for Dymer Creek Mainstem Station 21A	24
Figure 4.16A	30 Month Geometric Mean for Ashley Cove Station 16	24
Figure 4.16B	90 <sup>th</sup> Percentile for Ashley Cove Station 16	24
Figure 4.17A	30 Month Geometric Mean for Rones Bay	25
Figure 4.17B	90 <sup>th</sup> Percentile for Rones Bay	25
Figure 4.18A	30 Month Geometric Mean for Ashley Cove Station 16_5	25
Figure 4.18B	90 <sup>th</sup> Percentile for Ashley Cove Station 16_5	25
Figure 4.19A	30 Month Geometric Mean for Lees Cove	25
Figure 4.19B	90 <sup>th</sup> Percentile for Lees Cove	25
Figure 4.20A	30 Month Geometric Mean for Hunts Cove	26
Figure 4.20B	90 <sup>th</sup> Percentile for Hunts Cove	26
Figure 4.21A	30 Month Geometric Mean for Georges Cove & Poplar Neck	26
Figure 4.21B	90 <sup>th</sup> Percentile for Georges Cove	26
Figure 4.22A	30 Month Geometric Mean for Johnson Cove & Poplar Neck	26
Figure 4.22B	90 <sup>th</sup> Percentile for Johnson Cove	26
Figure 4.23A	30 Month Geometric Mean for Unnamed Cove to Dymer Creek	27
Figure 4.23B	90 <sup>th</sup> Percentile for Unnamed Cove to Dymer Creek	27
Figure 4.24A	30 Month Geometric Mean for Chases Cove	27
Figure 4.24B	90 <sup>th</sup> Percentile for Chases Cove	27
Figure 4.25A	30 Month Geometric Mean for Tabbs Creek Mainstem	27
Figure 4.25B	90 <sup>th</sup> Percentile for Tabbs Creek Mainstem	27
Figure 4.26A	30 Month Geometric Mean for Unnamed Trib (East) to Tabbs Cr.	28
Figure 4.26B	90 <sup>th</sup> Percentile for Unnamed Trib (East) to Tabbs Creek	28
Figure 4.27A	30 Month Geometric Mean for Unnamed Trib (West) to Tabbs Cr.	28
Figure 4.27B	90 <sup>th</sup> Percentile for Unnamed Trib (West) to Tabbs Creek	28
Figure 4.28A	30 Month Geometric Mean for Antipoison Creek Mainstem	28
Figure 4.28B	90 <sup>th</sup> Percentile for Antipoison Creek Mainstem	28
Figure 4.29A	30 Month Geometric Mean for Unnamed Cove (North) to Antipoison Creek	29
Figure 4.29B	90 <sup>th</sup> Percentile for Unnamed Cove (North) to Antipoison Creek	29
Figure 4.30A	30 Month Geometric Mean for Unnamed Cove (South) to Antipoison Creek	29
Figure 4.30B	90 <sup>th</sup> Percentile for Unnamed Cove (South) to Antipoison Creek	29
Figure 4.31A	30 Month Geometric Mean for Davenport	29
Figure 4.31B	90 <sup>th</sup> Percentile for Davenport Creek	29
Figure 4.32A	30 Month Geometric Mean for Harpers Creek	30
Figure 4.32B	90 <sup>th</sup> Percentile for Harpers Creek	30
Figure 4.33	Map of Shoreline Sanitary Survey for Indian, Dymer and Tabbs Crs.	31
Figure 4.34	Map of Shoreline Sanitary Survey for Antipoison & Davenport Crs.	32
Figure 4.35	Indian Creek and Tributaries Weighted BST by Source Type	38
Figure 4.36	Dymer Creek and Tributaries Weighted BST by Source Type	38
Figure 4.37	Tabbs Creek and Tributaries Weighted BST by Source Type	39
Figure 4.38	Antipoison Creek and Tributaries Weighted BST by Source Type	39
Figure B-1	Diagram to Illustrate Procedure Used to Estimate Fecal Coliform Production from Estimated Livestock Population	159



<u>List of Tables</u>		<u>Page</u>
Table 3.0	Indian Creek Watershed Percentages by Land Use Types	7
Table 3.1	Dyer Creek Watershed Percentages by Land Use Types	7
Table 3.2	Tabbs Creek Watershed Percentages by Land Use Types	8
Table 3.3	Antipoison Creek Watershed Percentages by Land Use Types	9
Table 4.1	Permitted Point Sources in Indian, Dyer, Tabbs, and Antipoison Creeks	14
Table 4.2	Domestic Animals and Septic Systems <i>observed</i> contributing pollution for Indian, Dyer, Tabbs, and Antipoison Creeks	15
Table 4.3	Pet and wildlife population <i>calculated estimates</i> for individual and collective watersheds	15
Table 4.4	Water Quality Data Summary - Indian Creek	17
Table 4.5	Water Quality Data Summary - Dyer Creek	18
Table 4.6	Water Quality Data Summary - Tabbs Creek	19
Table 4.7	Water Quality Data Summary - Antipoison Creek	19
Table 4.8	Summary of Bacterial Source Tracking samples for Indian, Dyer, Tabbs, and Antipoison Creeks	33
Table 4.9	Bacterial Source Tracking results for Indian Creek, Station 16-29B	34
Table 4.10	Bacterial Source Tracking results for Indian Creek, Station 16-30	34
Table 4.11	Bacterial Source Tracking results for Dyer Creek, Station 16-19B	35
Table 4.12	Bacterial Source Tracking results for Dyer Creek, Station 16-21A	35
Table 4.13	Bacterial Source Tracking results for Tabbs Creek, Station 16-13	36
Table 4.14	Bacterial Source Tracking results for Antipoison Creek, Station 17-8	36
Table 4.15	Isolate, Concentration, and Volume Weighted Average BST for Indian Creek by Type	37
Table 4.16	Isolate, Concentration, and Volume Weighted Average BST for Dyer Creek by Type	37
Table 4.17	Isolate, Concentration, and Volume Weighted Average BST for Tabbs Creek by Type	37
Table 4.18	Isolate, Concentration, and Volume Weighted Average BST for Antipoison Creek by Type	37
Table 5.1	Geometric Mean Analysis of Current Load & Estimated Load Reduction in Indian Creek	41
Table 5.2	Geometric Mean Analysis of Current Load & Estimated Load Reduction in Dyer Creek	41
Table 5.3	Geometric Mean Analysis of Current Load & Estimated Load Reduction in Tabbs Creek	42
Table 5.4	Geometric Mean Analysis of Current Load & Estimated Load Reduction in Antipoison Creek	42
Table 5.5	90th Percentile Analysis of Current Load and Estimated Load Reduction for Indian Creek	43
Table 5.6	90th Percentile Analysis of Current Load and Estimated Load Reduction for Dyer Creek	43
Table 5.7	90th Percentile Analysis of Current Load and Estimated Load Reduction for Tabbs Creek	44
Table 5.8	90th Percentile Analysis of Current Load and Estimated Load Reduction for Antipoison Creek	44

Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

Table 5.9	Monitoring Data for Enterococci at Indian Creek	45
Table 5.10	Summary for the Recreation Use Impairment in Indian Creek	45
Table 5.11A	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Indian Creek Main Stem	46
Table 5.11B	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Barnes Cove	46
Table 5.11C	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Henrys Cove	46
Table 5.11D	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Bells Cove	46
Table 5.11E	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Long Cove	47
Table 5.12A	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Dyer Creek Main Stem	47
Table 5.12B	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Ashley Cove	47
Table 5.12C	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Georges Cove	47
Table 5.12D	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Hunts Cove	48
Table 5.12E	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Lees Cove	48
Table 5.13	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Tabbs Creek Mainstem	48
Table 5.14A	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Antipoison Creek	48
Table 5.14B	Reductions/Allocations based upon 90 <sup>th</sup> Percentile Standard: Davenport Creek	49
Table 5.15	Kilmarnock WWTP Waste Load Allocation	49
Table 5.16A	TMDL Summary for Indian Creek (geometric mean)	51
Table 5.16B	TMDL Summary for Indian Creek (90 <sup>th</sup> percentile)	51
Table 5.17A	TMDL Summary for Dyer Creek (geometric mean)	52
Table 5.17B	TMDL Summary for Dyer Creek (90 <sup>th</sup> percentile)	52
Table 5.18A	TMDL Summary for Tabbs Creek (geometric mean)	52
Table 5.18B	TMDL Summary for Tabbs Creek (90 <sup>th</sup> percentile)	53
Table 5.19A	TMDL Summary for Antipoison & Davenport Creeks (Geometric mean)	53
Table 5.19B	TMDL Summary for Antipoison & Davenport Creeks (90 <sup>th</sup> percentile)	53
Table B.1	Fecal Production Rates Literature Review	151
Table B.2	GIS Data Elements	153
Table B.3	Non-point Source Load Distribution using Watershed Model	158
Table C.1	Observed Geometric Mean and 90 <sup>th</sup> Percentile for Indian Creek and Tributaries	160
Table C.2	Observed Geometric Mean and 90th Percentile for Dyer Creek and Tributaries	161
Table C.3	Observed Geometric Mean and 90th Percentile for Tabbs Creek	162
Table C.4	Observed Geometric Mean and 90th Percentile for Antipoison Creek and Tributaries, and Davenport Creek	163

## Executive Summary

This document details the development of bacterial a Total Maximum Daily Load (TMDL) for segments of the Indian, Dyer, Tabbs and Antipoin Creek watersheds in Northumberland and Lancaster Counties, Virginia.

The process of developing shellfish water TMDLs may be generalized in the following manner:

1. Water quality monitoring data are used to determine if the bacterial standard for shellfish have been violated;
2. Potential sources of fecal bacteria loading within the contributing watershed are identified;
3. The necessary reductions in fecal bacteria pollutant load to achieve the water quality standard are determined;
4. The TMDL study is presented to the public for comment, after which the final report is approved by the U. S. Environmental Protection Agency (USEPA) and the Virginia Water Control Board;
5. An implementation strategy to reduce fecal bacteria loads is written into a plan and subsequently implemented;
6. Water quality monitoring data are used to determine if the bacterial standard is being met for shellfish waters.

Two distinctly different approaches to determine the sources of fecal pollution in a waterbody are watershed modeling and bacterial source tracking (BST). Watershed modeling identifies potential sources based on information about conditions in the watershed (e.g. numbers of residents, estimated wildlife populations, estimated of livestock, etc.). BST identifies sources of fecal coliforms, specifically the dominant fecal coliform *Escherichia coli*, based on either genetic or phenotypic characteristics of the coliforms. Virginia's Department of Environmental Quality (VDEQ) uses BST, and specifically a method called antibiotic resistance analysis (ARA). This method assumes that fecal bacteria found in four sources: humans, wildlife, livestock, and pets will all differ in their reactions to antibiotics.

VDEQ expanded the impaired segments in the TMDL because annual Virginia Department of Health – Division of Shellfish Sanitation (VDH-DSS) shellfish condemnation assessments indicated that many additional tidal tributaries became impaired since the original 1998 listing. To reduce unnecessary resources spent on repeated TMDL developments for additional segments in the same watershed, VDEQ combined the most downstream mainstem condemnation with the largest number of tributary cove condemnations from previous VDH-DSS condemnations in the watersheds, using the combined surface area and volume of these areas in the TMDL development calculations. This is the concept of maximum extent for shellfish use TMDLs.

There were 2 original segments (the upper-most tidal portion of Indian Creek and Pitmans Cove) listed as condemned by Virginia Department of Health – Division of Shellfish Sanitation in 1998. VDEQ added 6 additional impaired segments in Indian Creek, including Arthur Cove, Bells Creek, Henrys Creek, Barnes Creek, and Long Creek and an additional downstream movement of the impaired segment of the Indian Creek main stem to just beyond Arthur Cove to this TMDL for development. These additions were based on the VDH-DSS condemnation notice dated January 28, 2005, a copy of which is included in Appendix A.

There were 2 original segments (the upper-most tidal portion of Dyer Creek and the up-stream portion of Hunts Cove) listed as condemned by Virginia Department of Health – Division of Shellfish Sanitation in 1998. VDEQ added 7 additional impaired segments in Dyer Creek, including Johnson

Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL Creek, Lees Cove, Ashleys Cove, Chases cove, and an additional downstream movement of the impaired segment of the Dyer Creek main stem up to just beyond Johnson Creek, an additional downstream movement of the impaired segment of Georges Cove to the confluence with Poplar Neck Creek, and a downstream movement of the condemnation in Hunts Cove to the mouth. These additions were based on the VDH-DSS condemnation notice dated January 28, 2005, a copy of which is included in Appendix A.

The upper-most tidal portion of Tabbs Creek was listed as condemned by the VDH – DSS in 1997. A downstream movement of the impaired segment in Tabbs Creek was included based upon VDH-DSS condemnation notice dated December 13, 2006. A copy of this notice is included in Appendix A.

The upper-most tidal portion of Antipoison Creek was listed as condemned by the VDH-DSS in 1996. Antipoison Creek's impairment moved downstream in the July 13, 2006 VDH condemnation listing. The impairment extends from the upper-most tidal portion of Antipoison Creek down to the creek's confluence with Little Bay and includes the small tributary to Little Bay named Davenport Creek.

The maximum extent condemnation in Indian Creek is identified as the upper-most tidal portion of Indian Creek to include Arthur Creek and Pitmans Creek (VAP-C01E-22-SF), Bells Creek (VAP-C01E-46-SF), Henrys Creek (C01E-44-SF), Barnes Creek (C01E-45-SF), and Long Creek (C01E-47-SF). There is also an un-named cove which is seasonally condemned in Indian Creek which at the time of the report, there was an insufficient number of samples to calculate a 30-month geometric mean or 90th percentile. The maximum extent condemnation in Dyer Creek is identified as the upper-most tidal portion of Dyer Creek to just above Poplar Neck Creek (VAP-C01E-24-SF) and includes Chases Cove (VAP-C01E-48-SF) and Johnson Creek (VAP-C01E-26-SF), Georges Cove (VAP-C01E-25-SF), Hunts Cove (VAP-C01E-49-SF), and Lees Cove (C01E-20-SF). Ashley Cove was condemned by VDH in 1/28/05 and then re-opened in 12/13/06; therefore the VDEQ assessment cycle was unable to capture the active closure and thus was not considered "impaired" by DEQ. However, because DEQ uses the "maximum extent" scenario for condemnations listed by VDH-DSS, Ashley Cove has been included in this TMDL report. The maximum extent condemnation in Tabbs Creek is identified as the main stem portion to just before the mouth of the creek (VAP-C01E-27-SF). The maximum extent condemnation in Antipoison Creek is the main stem portion of the creek to the mouth (VAP-C01E-28-SF, VAP-C01E-50-SF, and VAP-C01E-51-SF) and in the same growing area, Davenport Creek (VAP-C01E-34-SF), which is also condemned to the mouth. The applicable state standard specifies that the number of fecal coliform bacteria shall not exceed a maximum allowable level of geometric mean of 14 most probable number (3-tube MPN) per 100 milliliters (ml) and a 90<sup>th</sup> percentile geometric mean value of 49 MPN/100ml (Virginia Water Quality Standard 9-VAC 25-260-5). In development of this TMDL, the 90<sup>th</sup> percentile 49 MPN/100 ml was used because it represented the more stringent standard.

Potential sources of fecal coliform consist primarily of non-point source contributions, and include permitted point source discharges in the watershed. Non-point sources include wildlife; livestock; land application of bio-solids; recreational vessel discharges; failed, malfunctioning, or non-operational septic systems; and uncontrolled discharges (straight pipes conveying gray water from kitchen and laundry areas of private homes, etc.).

Virginia DEQ and the Virginia Department of Health collaborated to use a simplified volumetric approach to develop the TMDL. The goal of the procedure is to use bacteriological source tracking (BST) data and bathymetric data to determine the sources of fecal coliform violations, the estuarine volumes and the load reductions needed to attain the applicable criteria.

## Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL

To assist in partitioning the loads from the diverse sources within the watershed, BST samples of fecal coliform bacteria were collected monthly for one year. These samples were compared to a reference library of fecal samples from known sources. The resulting data were used to assign portions of the load within the watershed to wildlife, humans, pets or livestock. The results of this analysis indicated that in Indian, Dymer and Antipoison Creeks, the primary sources of fecal coliforms were the anthropogenic sources of human, pet and livestock, followed by wildlife as a background contributor. In Tabbs Creek the primary source of fecal coliforms was wildlife, followed by human, livestock and pets. The presence of large signatures attributable to different components is sufficient to establish potential directions for remediation under a future implementation plan.

### Load Allocation Scenarios

The next step in the TMDL process was to determine the appropriate water quality standard to be applied. This was set as the 90<sup>th</sup> percentile standard because the data established that the 90<sup>th</sup> percentile had the higher violation rates, and required the greater reduction compared to the geometric mean. Calculated results for each segment were used to establish the existing load in the system. The load necessary to meet water quality standards was calculated in a similar fashion using the water quality standard criterion in place of the ambient water quality value. The difference between these two numbers represents the necessary level of reduction in each segment. The results of the load calculations and the reductions necessary for each watershed and segment are shown below.

#### 90<sup>th</sup> Percentile Analysis of Current Load and Estimated Load Reduction In Growing Area 016: Indian Creek

("Indian Creek Main Stem" includes Pitmans Cove and Arthur Cove)

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Indian Creek Main Stem	2113725	854.2	49	Implicit	1.81E+13	1.04E+12	94%
Barnes Creek	745896	79.4	49		5.92E+11	3.65E+11	38%
Henry's Creek	434780	71.8	49		3.12E+11	2.13E+11	32%
Bells Creek	254665	68.5	49		1.75E+11	1.25E+11	28%
Long Creek	64641	93.2	49		6.02E+10	3.17E+10	47%



**90<sup>th</sup> Percentile Analysis of Current Load and Estimated Load Reduction  
In Growing Area 016: Dyer Creek**

("Dyer Creek Main Stem" includes Johnson Creek and Chases Cove)

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Dyer Creek Main Stem	1683593	606.7	49	Implicit	1.02E+13	8.25E+11	92%
Ashley Cove	239334	66.1	49		1.58E+11	1.17E+11	26%
Georges Cove	142993	127.6	49		1.82E+11	7.01E+10	62%
Hunts Cove	214452	81.5	49		1.75E+11	1.05E+11	40%
Lees Cove	51140	103.9	49		5.31E+10	2.51E+10	53%

**90<sup>th</sup> Percentile Analysis of Current Load and Estimated Load Reduction  
In Growing Area 016: Tabbs Creek**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Tabbs Creek	1094019	1015.5	49	Implicit	1.11E+13	5.36E+11	95%

**90<sup>th</sup> Percentile Analysis of Current Load and Estimated Load Reduction  
In Growing Area 017: Antipoison and Davenport Creeks**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Antipoison Creek	1755494	159.8	49	Implicit	2.81E+12	8.60E+11	69%
Davenport Creek	28118	283.9	49		7.98E+10	1.38E+10	83%

## Waste Load Allocation Indian Creek - Growing Area 016 Kilmarnock WWTP

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Fecal Coliform Limit (Geometric mean) (MPN/100ml)	Total Daily Load Outfall 001 or 002 (MPN/day)	Future Growth Factor of 1% (MPN/day)	Total Annual Load Outfall 001 or 002 (MPN/year)	Total Daily WLA for Kilmarnock WWTP (MPN/day)
0.5	1.89E+09	14	2.65E+08	2.65E+06	9.78E+10	2.68E+08

Indian Creek near Kilmarnock Wharf (station 7-IND002.26) was listed as impaired for the primary use (recreational) in VDEQ's 2006 water quality assessment and was re-listed in the 2008 draft assessment report. This report document also includes a primary contact TMDL, shown below. It should be noted the shellfish water quality standard is more stringent than the primary contact standard. Attainment of the shellfish standards will automatically ensure that primary contact standards are being met.

### TMDL Summary for the Recreation Use Impairment in Indian Creek

Impaired Water body Segment	Volume (m <sup>3</sup> )	Bacteria Pollutant	Current Load (cfu/day)	Load Allocation (cfu/day)	Wasteload Allocation (cfu/day)	TMDL (cfu/day)	Required Reduction
Indian Creek (C01E-29-BAC) Northumberland County	2128364	<i>Enterococci</i>	1.70E+13	2.21E+12	6.69E+08	2.21E+12	87%

### Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

### Recommendations for TMDL Implementation

The goal of this TMDL was to develop an allocation plan that achieves water quality standards during the implementation phase. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19.7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters."

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technologies, the

Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL installation of best management practices (BMPs) and designation of a No Discharge Zone (NDZ), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The TMDL developed for the Indian, Dymmer, Tabbs, and Antipoison Creeks watershed impairments provides allocation scenarios that will be a starting point for developing implementation strategies. Additional monitoring aimed at targeting the necessary reductions is critical to implementation development. Once established, continued monitoring will aid in tracking success toward meeting water quality milestones.

Public participation is critical to the implementation process. Reductions in non-point source loading are the crucial factor in addressing the problem. These sources cannot be addressed without public understanding of and support for the implementation process. Stakeholder input will be critical from the onset of the implementation process in order to develop an implementation plan that will be truly effective.

## **Public Participation**

During development of the TMDL for the Indian, Dymmer, Tabbs, and Antipoison Creeks watersheds, public involvement was encouraged through a public participation process that included public and stakeholder meetings and public comment periods.

The first technical advisory committee and public meetings were held on September 29, 2008. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. The TMDL load allocations were presented during the second public meeting held on November 14, 2008. The public meetings were advertised in the local media, signs advertising the meeting were placed at high access road intersections in the watershed for two weeks before the meetings, and email invitations were sent to local government and stakeholders. There were 9 public comments received during the first public comment period and 7 public comments received during the final public comment period.

## 1.0 Introduction

This document details the development of bacterial Total Maximum Daily Load (TMDL) for segments of the Indian Creek, Dymer Creek, Tabbs Creek, and Antipoison Creek watersheds in Northumberland and Lancaster Counties, Virginia. Two portions of Indian Creek, the uppermost tidal portion of the Indian Creek mainstem above Arthur Cove, and Pitmans Cove, were listed as impaired for shellfish use on Virginia's 1998 303(d) Total Maximum Daily Load Priority List. Two segments were also on the 1998 303(d) TMDL Priority List in Dymer Creek; the upper most tidal portion of the Dymer Creek mainstem above Chase Cove, and Georges Cove. The original 1998 303(d) listing for Tabbs Creek comprised a smaller section of the Tabbs Creek mainstem. The 1996 VDH listing of Antipoison Creek extended from the upper-most tidal portion of the creek down to Chilton.

Due to annual VDH-DSS shellfish condemnation assessments, impaired shellfish waters often fluctuate in area and volume, as well as presence or absence of condemnations from year to year. An impaired area may be added to the 303(d) impaired waters list during one assessment cycle, and undergo several evolutions in size during the VDH-DSS cycles prior to TMDL development. Under this dynamic condition, and to reduce unnecessary resources spent on repeated TMDL developments in the same watersheds, VDEQ determined the maximum extent of condemned areas of all tidal portions of Indian, Dymer, Tabbs, and Antipoison Creek and their tributaries from all past VDH-DSS condemnations for development of this TMDL. VDEQ combined the most downstream mainstem condemnation with the largest number of tributary and cove condemnations in previous VDH-DSS condemnations in this watershed, using the combined surface area and volume of these areas in the TMDL development calculations. This is the concept of maximum extent in shellfish use TMDLs.

For this reason, VDEQ added 6 additional impaired segments in Indian Creek, including Arthur Cove, Bells Creek, Henrys Creek, Barnes Creek, and Long Creek and an additional downstream movement of the impaired segment of the Indian Creek mainstem to just below Arthur Cove to this TMDL for development. These additions were based on the VDH-DSS condemnation notice dated January 28, 2005, a copy of which is included in Appendix A.

VDEQ also added 7 additional impaired segments in Dymer Creek, including Johnson Creek, Hunts Cove, Lees Cove, Ashleys Cove, Chases Cove, and an additional downstream movement of the impaired segment of the Dymer Creek mainstem up to just below Johnson Creek, and an additional downstream movement of the impaired segment of Georges Cove to the confluence with Poplar Neck Creek. These additions were based on the VDH-DSS condemnation notice dated January 28, 2005, a copy of which is included in Appendix A.

A downstream movement of the impaired segment in Tabbs Creek (approximately 760 meters downstream) was included based upon VDH-DSS condemnation notice dated December 13, 2006. A copy of this notice is included in Appendix A.

Antipoison Creek's impairment also moved downstream for the July 13, 2006 VDH condemnation listing. The maximum extent impairment extends from the upper-most tidal reach down to the confluence with Little Bay and includes Davenport Creek.

A TMDL is just one step in a multi-step process that includes a high level of public participation in order to address water quality issues that can affect public health and the health of aquatic life. Water quality standards are regulations based on federal or state law that set numeric or narrative limits on pollutants. Water quality monitoring is performed to measure these pollutants and determine if the

measured levels are within the standards set for the uses designated for the waterbody. The waterbodies which have pollutant levels above the designated standards are considered impaired for the corresponding designated use (e.g. swimming, drinking, shellfish harvest, etc.). The impaired waterways are listed on the §303 (d) list reported to the Environmental Protection Agency. Those waters placed on the list require the development of a TMDL intended to eliminate the impairment and bring the water into compliance with the designated standards.

TMDLs represent the total pollutant loading that a water body can receive without violating water quality standards. The TMDL process establishes the allowable loading of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions.

Fecal coliform bacteria are the most common cause for the impairments in Virginia shellfish growing waters. Fecal coliforms are associated with the fecal material derived from humans and warm-blooded animals. The presence of fecal coliform bacteria in aquatic environments is an indication that the water may have been contaminated by pathogens or disease-producing bacteria or viruses. Waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. Filter-feeding shellfish can concentrate these pathogens which can be transmitted and cause disease when eaten uncooked. Therefore, the presence of elevated numbers of fecal coliform bacteria is an indicator that a potential health risk exists for individuals consuming raw shellfish.

The Virginia Department of Environmental Quality (VDEQ) and the Virginia Department of Health – Division of Shellfish Sanitation (VDH-DSS) use a source identification method called bacterial or microbial source tracking (BST or MST) to assist with assigning load allocations for non-point sources. This method is discussed in section 4.4.

## **1.1 Overview of the TMDL Development Process**

A TMDL study for shellfish waters is the first part of a phased process aimed at restoring water quality. This study is designed to determine how much of the pollutant input needs to be reduced in order to achieve water quality standards. The second step in the process is the development of an implementation plan that identifies which specific control measures are necessary to achieve those reductions, their timing for implementation and at what cost. The implementation plan will also outline potential funding sources. The third step will be the actual implementation process. Implementation will typically occur in stages that allow a review of progress in reducing pollutant input, refine bacteria loading estimates based upon additional data and make any identified changes to pollutant control measures. The TMDL development process also must account for seasonal and annual variations in precipitation, flow, land use, and pollutant contributions.

## **2.0 Designated Uses and Applicable Water Quality Standard**

Water quality standards are provisions of state or federal law which consist of a designated use or set of uses for the waters and water quality criteria based upon such uses. The purpose of water quality standards is to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). According to Virginia Water Quality Standards (9 VAC 25-260-5), the term “*water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters*”



*based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."*

## **2.1 Designated Uses and Criteria**

Generally, all tidal waters with salinity in Virginia are designated as shellfish waters. The identification of the applicable river reaches can be found in the river basin tables at 9VAC25-260-390 et seq. For a shellfish supporting water body to be in compliance with Virginia bacterial standards, VDEQ specifies the following criteria (9 VAC 25-260-160): *"In all open ocean or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health the following criteria for fecal coliform bacteria shall apply; The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) of 14 per 100 milliliters. The 90<sup>th</sup> percentile shall not exceed an MPN of 43 for a 5 tube, 3 dilution test or 49 for a 3 tube, 3 dilution test, or MF test of 31 CFU (colony forming units) per 100 milliliters.*

## **2.2 Classification of Virginia's Shellfish Growing Areas**

The Virginia Department of Health, Division of Shellfish Sanitation is responsible for classifying shellfish waters. The VDH- DSS follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP specifies the use of a shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in water samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline survey and to define the border between approved and condemned (unapproved) waters.

DSS designs and operates the shoreline survey to locate sources of pollution within the watersheds of shellfish growing areas. This is a property-by-property inspection of the onsite sanitary waste disposal facilities on un-sewered sections of watersheds, of other sources of pollution such as wastewater treatment plants (WTP), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found. Once an onsite problem is identified, local health departments (LHDs), and/or other state and local agencies may play a role in the process of correcting the deficiencies.

The VDH-DSS collects monthly seawater samples at over 2,000 stations in the shellfish growing areas of Virginia. Though they continuously monitor sample data for unusual events, they evaluate shellfish growing areas on an annual basis. The annual review uses data from the most recent 30 samples (typically 30 months), collected randomly with respect to weather. The data are assessed to determine whether the water quality standards are met. If the water quality standards are exceeded, the shellfish area is closed for the harvest of shellfish that go directly to market. Those areas that marginally exceed the water quality standard and are closed for the direct marketing of shellfish are eligible for harvest of shellfish under permit from the Virginia Marine Resources Commission and VDH-DSS. The permit establishes controls that in part require shellfish be allowed to depurate for 15 days in clean growing areas or specially designed licensed on shore facilities. Shellfish in growing areas that are assumed to be highly polluted, such as those in the immediate vicinity of a wastewater treatment facility (prohibited waters), are not allowed to be moved to clean waters for self purification.

### **3.0 Watershed Characterization**

#### **Indian Creek & Tributaries**

The Indian Creek watershed is split between Lancaster (south) and Northumberland (north) Counties. It is classified as Condemnation Area 057, Growing Area 016, consisting of the upper most tidal portion of the Indian Creek mainstem to just below Arthur and Pitmans Cove and also includes Bells Creek, Long Creek, Henry Creek, and Barnes Creek. An un-named cove (Section M-1 in Condemnation #016-057) just east of Arthur Cove is an administrative closure which is seasonally condemned by VDH-DSS due to its proximity to a marina. This administrative closure does not require a TMDL. The drainage area of the Indian Creek watershed is approximately 9.1 square miles (5814 acres). The initial listing and maximum extent listing may be found in Appendix A.

#### **Dymer Creek & Tributaries**

The Dymer Creek watershed in Lancaster County is classified as Condemnation Area 024, Growing Area 016, consisting of the upper most tidal portion of the Dymer Creek mainstem to just below Johnson Creek and Chases Cove and includes Hunts Cove, Lees Cove, Ashleys Cove, and a portion of Georges Cove. The drainage area of the Dymer Creek watershed is approximately 8.4 square miles (5397 acres). The initial listings and maximum extent listing may be found in Appendix A.

#### **Tabbs Creek**

The Tabbs Creek watershed lies in Lancaster County and is classified as Condemnation Area 133, Growing Area 016, and consists of the upper mainstem portion of Tabbs Creek down to approximately 300 meters upstream of its confluence with Fleets Bay. The drainage area of the Tabbs Creek watershed is approximately 2.7 square miles (1716 acres). The initial listings and maximum extent listing may be found in Appendix A.

#### **Antipoison Creek & Davenport Creek**

The Antipoison Creek watershed is Condemnation Area 188, Growing Area 017, and is located in Lancaster County on Little Bay. This condemnation includes a small creek just north of Antipoison, named Davenport Creek. The drainage area of the Antipoison Creek watershed is approximately 3.8 square miles (2403 acres). The initial listings and maximum extent listing may be found in Appendix A.

#### **Collective Watershed**

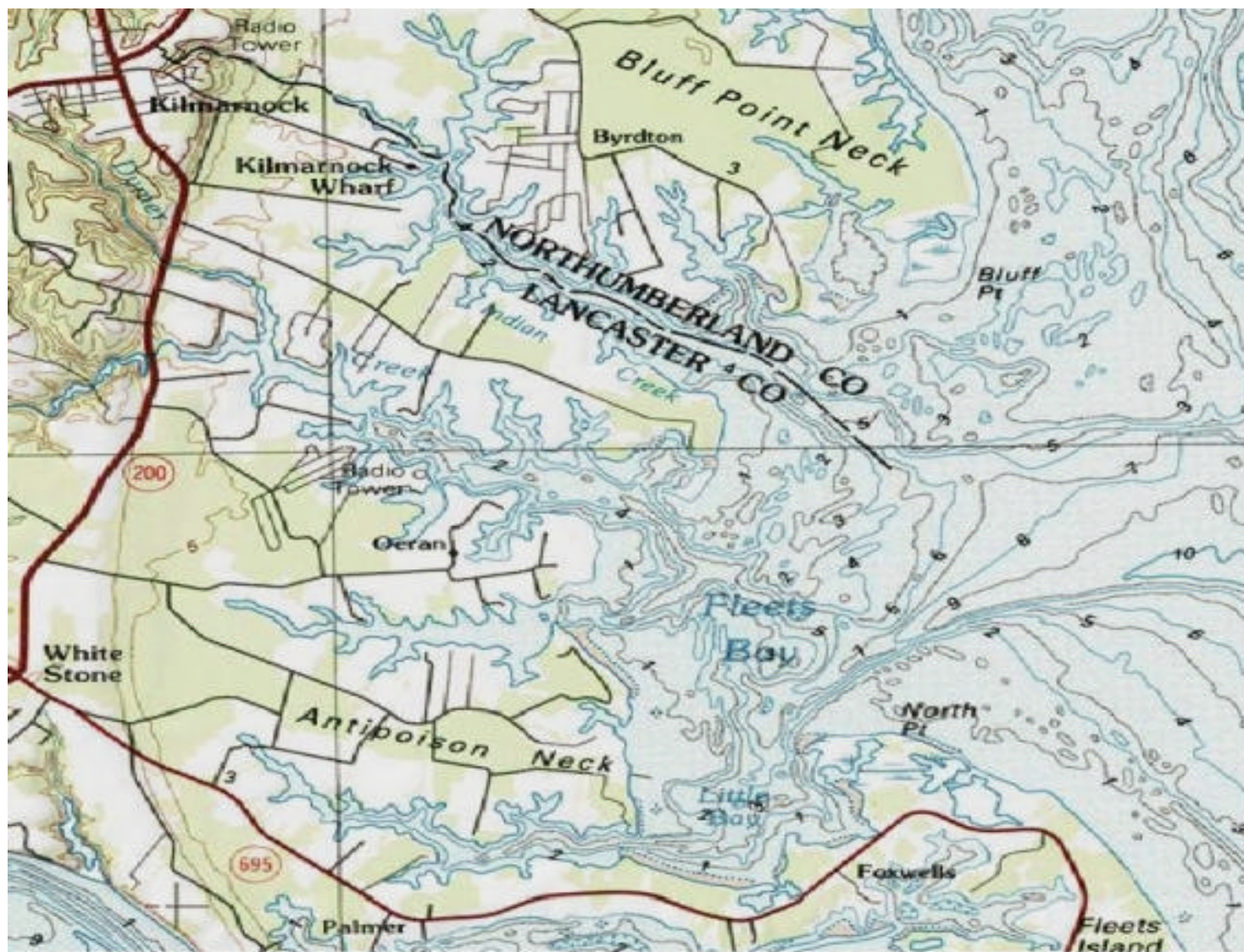
The collective watershed occupies a landscape position which straddles Northumberland County (northward to include portions of Indian Creek) and Lancaster County (southward to include portions of Indian and includes Tabbs, Dymer, Antipoison, and Davenport Creeks). Indian, Tabbs, and Dymer Creeks flow into Fleets Bay and into the Chesapeake Bay. Antipoison and Davenport Creeks flow into Little Bay and then into Fleets Bay and then into the Chesapeake Bay (Figure 3.0). The collective watershed is bound on the west by route 3, routes 608 and 669 to the north and north-east, and route 695 to the south. The communities of Kilmarnock, Byrdton, Lynhams, Kilmarnock Wharf, Ocran, White Stone, Palmer, and Foxwells are located within the collective watershed. The drainage area of the collective watershed is approximately 24.0 square miles (15,330 acres). Population estimate according to the 2006 Census for the town of Kilmarnock was 1201 and 344 in White Stone. Population data for the towns of Byrdton, Lynhams, Kilmarnock Wharf, Ocran, Palmer, and Foxwells were not available. Population is considered sparse to moderate throughout the collective watershed

Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL with the majority of the population residing in or close to the towns of Kilmarnock and White Stone (DSS Shoreline Survey Lancaster and Northumberland Counties 2003).

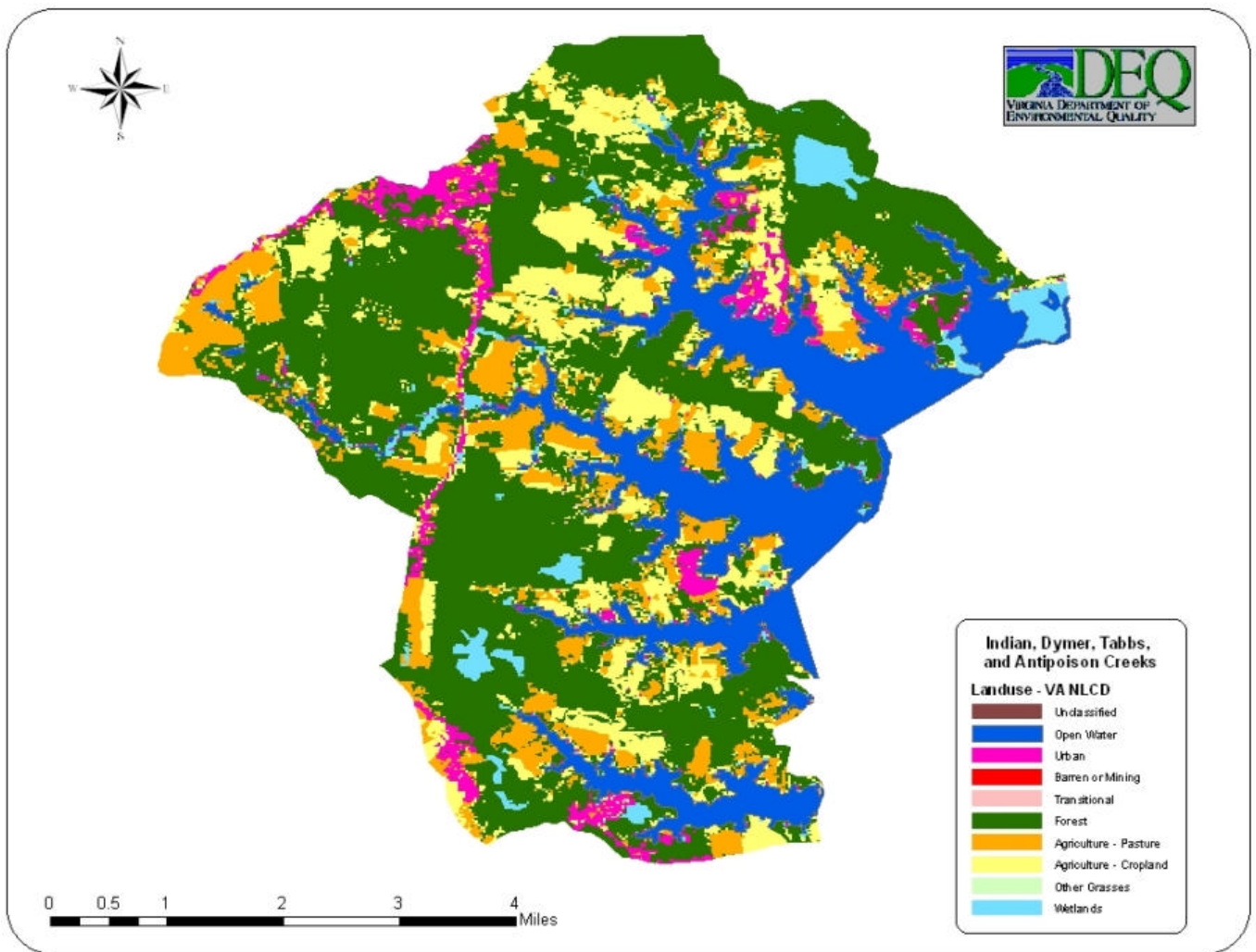
Some portions of shellfish growing areas are either permanently or seasonally closed to direct shellfish harvesting due to the presence of either marinas or wastewater treatment facility discharges. In these cases, DSS uses a computer model to determine the size and shape of the closure area based on the potential fecal input, *e.g.*, number of boats in a marina or the number of gallons of sewage permitted for the treatment facility. DSS is careful to ensure that a sufficient area is closed to protect public health under even high pollution events without condemning excessive waters.

Section C of Indian Creek is permanently closed due to the presence of the Kilmarnock Wastewater Treatment Plant. These shellfish waters are permanently closed to shellfish harvesting as a public safety measure due to the possible presence of viral pathogens. A list of all permitted point sources in Indian, Dymer, Tabbs, and Antipoison Creeks may be found in Section 4.3, Table 4.1.

**Figure 3.0 Indian, Dymer, and Tabbs and Antipoison Creeks and Tributaries Topographic Map**





**Figure 3.1 Indian, Dyer, and Tabbs Creeks and Tributaries Watershed Land Use Map**

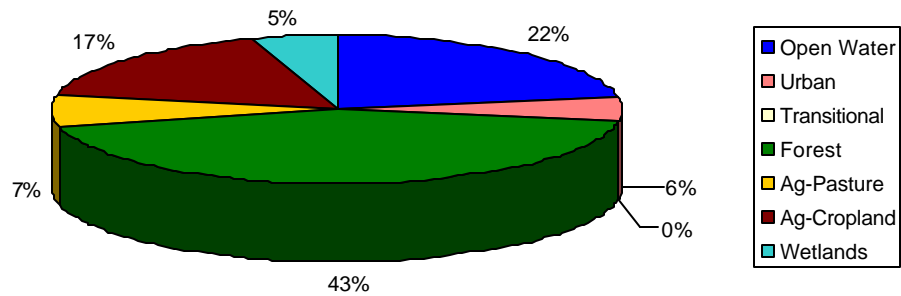
### Land Use

Land use in the individual watersheds is shown in Figures 3.1 through 3.5 and Tables 3.0 through 3.3. In all four creeks, approximately three-quarters (70%) of the land use in each of the watersheds is comprised of undeveloped forest, wetland, and open water (forest+wetland+open water). The creeks also have similar amounts of agricultural land use (ag-pasture + ag-farmland) of about 25% per watershed. Developed and residential lands (termed “urban”) occupy about 5% of the land use within each of the creeks. Residential or “urban” land use is shown as concentrations within Antiposition Creek (6%) along the water’s edge near Palmer, around Ocran off Ashleys Cove in Dyer Creek, and at several points along the Northumberland side of Indian Creek and along Kilmarnock Wharf. There are also concentrations of “urban” land use along Rt. 3 which lies to the west of the tidal creeks and heads north from White Stone to Kilmarnock. There was no reported use of “transitional” land. Land use information was gathered from the 1992 National Land Cover Database (NLCD).

**Table 3.0 Indian Creek Watershed Percentages by Land Use Types**

Land Use Type	Acres	Square Miles	Percent
Open Water	1291	2.02	22%
Urban	324	0.51	6%
Transitional	0	0	0%
Forest	2524	3.94	43%
Agri - Pasture	411	0.64	7%
Agri - Cropland	997	1.56	17%
Wetland	268	0.42	5%
<b>Totals:</b>	<b>5814</b>	<b>9.09</b>	<b>100%</b>

**Figure 3.2 Indian Creek Land Use Percentages by Type**

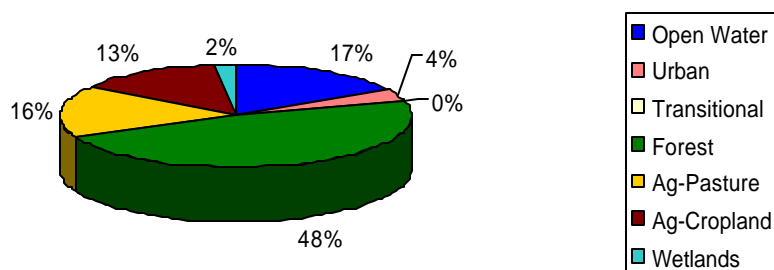


**Table 3.1 Dymmer Creek Watershed Percentages by Land Use Types**

Land Use Type	Acres	Square Miles	Percent
Open Water	910	1.42	17%
Urban	198	0.31	4%
Transitional	5	0.01	0%
Forest	2578	4.03	48%
Agri - Pasture	876	1.37	16%
Agri - Cropland	727	1.14	13%
Wetland	103	0.16	2%
<b>Totals:</b>	<b>5397</b>	<b>8.44</b>	<b>100%</b>



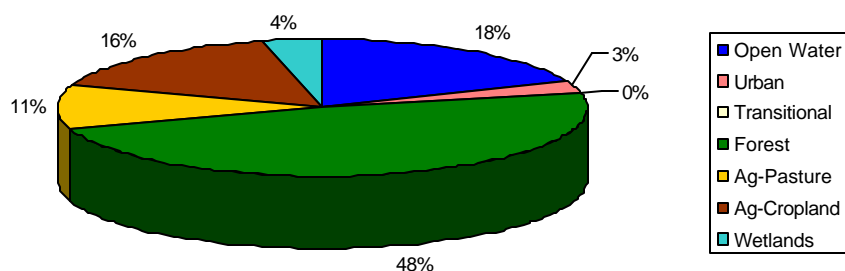
**Figure 3.3 Dymer Creek Land Use Percentages by Type**



**Table 3.2 Tabbs Creek Watershed Percentages by Land Use Types**

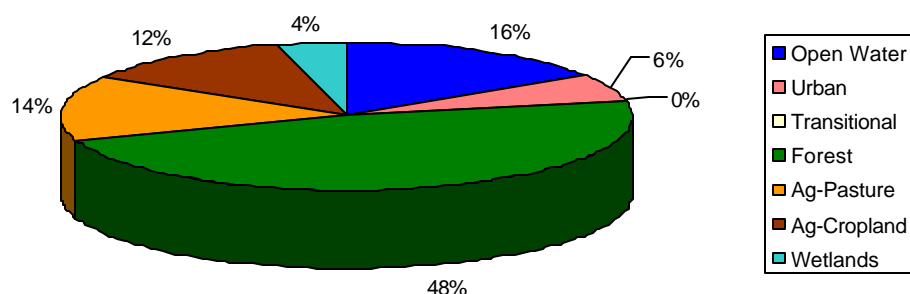
Land Use Type	Acres	Square Miles	Percent
Open Water	313	0.49	18%
Urban	54	0.08	3%
Transitional	0	0	0%
Forest	832	1.30	48%
Agri - Pasture	182	0.28	11%
Agri - Cropland	272	0.43	16%
Wetland	63	0.10	4%
<b>Totals:</b>	<b>1716</b>	<b>2.68</b>	<b>100%</b>

**Figure 3.4 Tabbs Creek Land Use Percentages by Type**



**Table 3.3 Antipoison Creek Watershed Percentages by Land Use Types**

Land Use Type	Acres	Square Miles	Percent
Open Water	376	0.59	16%
Urban	144	0.22	6%
Transitional	0	0.00	0%
Forest	1158	1.81	48%
Agri - Pasture	337	0.53	14%
Agri - Cropland	298	0.47	12%
Wetland	90	0.14	4%
<b>Totals:</b>	<b>2403</b>	<b>3.76</b>	<b>100%</b>

**Figure 3.5 Antipoison Creek Land Use Percentages by Type**

### 3.1 Geology and Soils

Indian, Dyer, Tabbs, and Antipoison Creeks and Tributaries are in the Atlantic Coastal Plain physiographic region. The Atlantic Coastal Plain is the easternmost of Virginia's physiographic provinces. The Atlantic Coastal Plain extends from New Jersey to Florida, and includes all of Virginia east of the Fall Line. The Fall Line is the easternmost extent of rocky-river rapids, the point at which east-flowing rivers cross from the hard, igneous and metamorphic rocks of the Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain. The Coastal Plain is underlain by layers of Cretaceous and younger clay, sand, and gravel that dip gently eastward. These layers were deposited by rivers carrying sediment from the eroding Appalachian Mountains to the west. As the sea level rose and fell, fossiliferous marine deposits were inter-layered with fluvial, estuarine, and beach strata. The youngest deposits of the Coastal Plain are sand, silt and mud presently being deposited in our bays and along our beaches (<http://www.geology.state.va.us/DOCS/Geol/coast.html>).

## Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL

Soils for the Indian, Dymer, Tabbs, and Antipoison Creeks and tributaries watershed were documented utilizing the VA State Soil Geographic Database (STATSGO). Three general soil types were

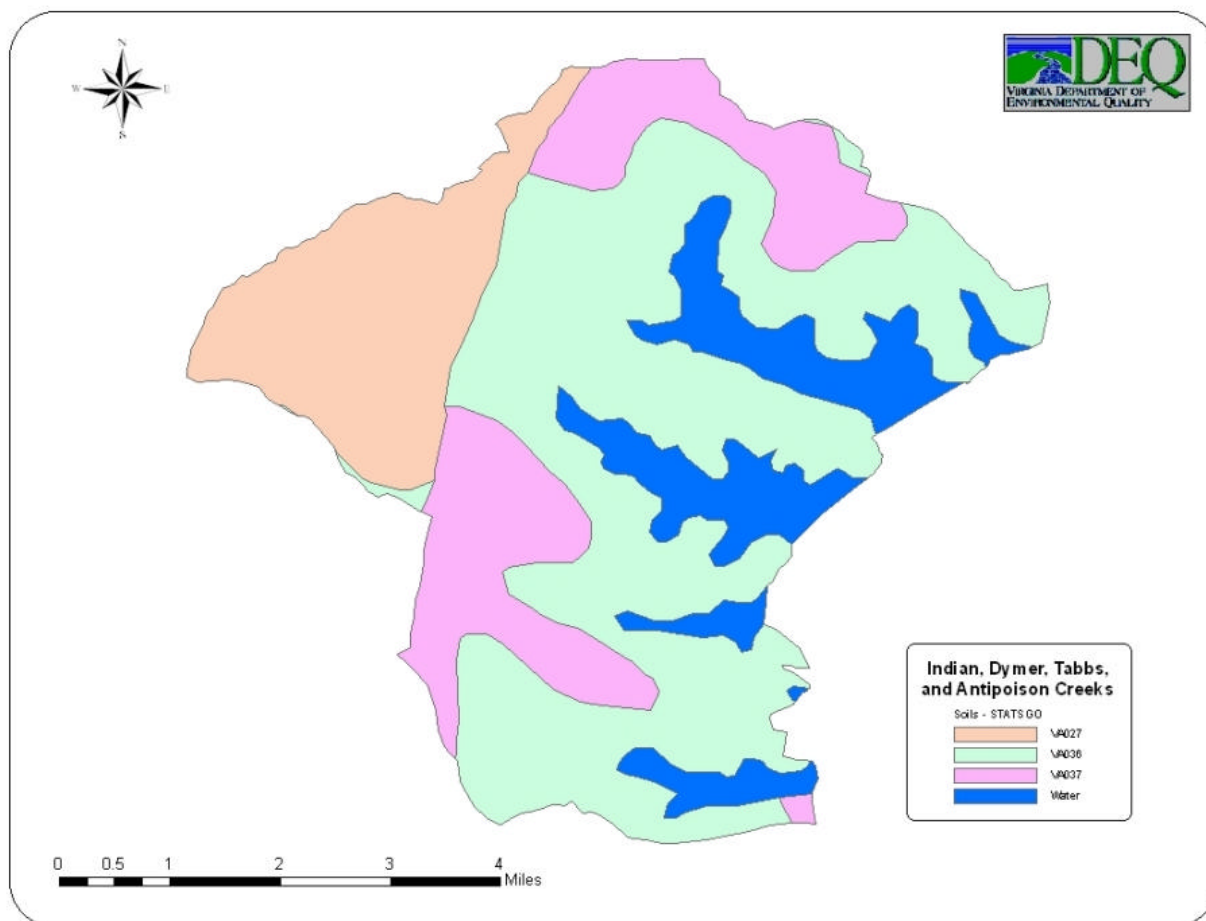
identified in this database. Descriptions of these soil series were derived from queries to the USDA Natural Resources Conservation Service (NRCS) Official Soil Series Description web site (<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi>). Figure 3.6 shows the location of these general soil types in the watershed.

Soils of the Emporia-Johnston-Kenansville-Remlik-Rumford-Slagle-Suffolk-Tomotley (VA027) series are very deep to deep, and vary between well drained to poorly drained with moderately slow or slow permeability. They formed in moderately fine-textured stratified fluvial and marine sediments on the upper Coastal Plain and stream terraces.

Soils of the Tetotum-Nansemond-State-Emporia-Dragston-Nimmo-Bladen Series (VA036) are very deep and range from well drained to poorly drained. Permeability ranges from moderately rapid and/or rapid to moderately slow or slow. This soil series was formed in sandy or loamy fluvial and marine sediments on Coastal Plain uplands and stream terraces.

Soils of the Bibb and Levy-Bohicket-Lumbee-Nansemond-Rumford-Tetotum-State-Suffolk (VA037) are very deep to deep, and vary from well drained to very poorly drained. They range in slope from 0 – 15 percent. Their water capacity varies from low to high. This soils series was formed in sandy to loamy to mucky clay alluvial and marine sediments on the upper Coastal Plain and stream terraces.

Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL  
**Figure 3.6 Indian, Dymer, Tabbs, and Antipoison Creeks & Tributaries Soils Map**



## 4.0 Water Quality Impairment and Bacterial Source Assessment

### 4.1 Water Quality Monitoring

The VDH-DSS water quality monitoring network for Indian Creek consists of nineteen monitoring stations throughout the embayment. There are sixteen monitoring stations throughout Dymer Creek, 8 monitoring stations throughout Tabbs Creek, and eleven monitoring stations in Antipoison and Davenport Creeks. These stations are monitored by the VDH-DSS for fecal bacteria. The locations of the water quality monitoring stations utilized for this study are shown in Figure 4.1.

This TMDL study examined bacterial monitoring data at these stations from December 1984 through July 2008. A summary of water quality data from the stations in or bordering condemned areas of maximum extent for the monitoring period preceding the TMDL study (historic data) is shown in Tables 4.4 through 4.7.

Graphs depicting the geometric mean and 90<sup>th</sup> percentile for the condemned areas of Indian Creek are shown in Figures 4.2A – 4.10A plus 4.12 A & B; Figures 4.11 A & B plus 4.13A – 4.24B for Dymer Creek; Figures 4.25A – 4.27B for Tabbs Creek; and in Figures 4.28A – 4.32B Antipoison and Davenport Creeks. The closures in the growing areas are characterized based on all monitoring stations (see Figure 4.1) in the condemnation areas.

VDEQ also monitors for Enterococci, an organism used for detection of bacteria for the primary contact or recreational use in Virginia's brackish (estuarine) waterways as it is a good indicator of

Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL human pathogens. The upper-tidal portion of Indian Creek near Kilmarnock Wharf (station 7-IND002.26) was assessed as not supporting the recreational use in 2006. It has been re-listed as not supporting the recreational use in 2008 with a violation rate of 6/39 (15% violations). Due to the conservative nature of shellfish water quality standards, the implementation of the shellfish TMDL in Indian Creek is expected to achieve the reductions needed to meet the primary contact water quality standards. Therefore, a separate primary contact TMDL was deemed unnecessary for Indian Creek. Dymer, Tabbs, and Antipoison Creeks were not listed for recreational impairments in the last two assessment cycles. The summary of monitoring data for the primary contact impairment is available in Table 5.9.

## **4.2 Condemnation Areas**

Two segments in both the Indian Creek and Dymer Creek portions of the watershed and one segment within Tabbs Creek were listed as impaired on Virginia's 1998 303(d) water quality standard for fecal coliform bacteria in shellfish supporting waters. A smaller condemnation which included only the upper-most tidal portion of the Antipoison Creek watershed was listed as impaired on Virginia's 1996 303 (d) water quality standard for fecal coliform bacteria in shellfish supporting waters. However, the TMDL is using the VDH-DSS condemnation areas dated 1/28/05 for Indian Creek, 12/13/06 for Tabbs Creek, 1/28/05 for Dymer Creek, and 7/13/04 for Antipoison Creek because these present the condemnation areas of maximum extent to date, as explained in Section 1.0 of this report. The use of maximum extent in regards to shellfish condemnations results in the most protective load allocations.

These maximum extent condemnations contain 7 impaired segments in Indian Creek (including the two original impaired segments listed in 1998): Indian Creek mainstem, Arthur Cove, Bells Creek, Henrys Creek, Barnes Creek, Long Creek, and Pitmans Cove.

There are 7 impaired segments in Dymer Creek (including the two original impaired segments listed in 1998) Dymer Creek mainstem, Johnson Creek, Hunts Cove, Lees Cove, Ashleys Cove, Georges Cove, and Chase Cove.

The impairment in Tabbs Creek is an extended portion of the mainstem from the original 1998 listing.

The Antipoison Creek impairment includes the originally listed uppermost tidal segment which is extended out to the mouth at Little Bay. This condemnation includes a small embayment, Davenport Creek, which is also impaired to its confluence with Little Bay.

Detailed maps of the shellfish condemnation areas and their associated water quality stations are available from the Virginia Department of Health, Division of Shellfish Sanitation. A map of the condemnation areas is shown in Figure 4.1. Copies of the original and subsequent condemnation notices of all closures are in Appendix A.

## **4.3 Fecal Coliform Bacteria Source Assessment**

### **A. Point Sources**

The Kilmarnock Waste Water Treatment Plant is the only facility permitted for fecal coliform control and discharges to Indian Creek. There are no facilities permitted for fecal coliform control in Dymer, Tabbs, and Antipoison Creeks. Therefore, the Kilmarnock Waste Water Treatment Plant is the only discharger to receive a Waste Load Allocation (WLA) in this report. Table 4.1 illustrates all facilities with DEQ permits within the 4 watersheds.



### **Indian Creek & Tributaries**

The Kilmarnock Waste Water Treatment Plant (WWTP) (VA0020788) which operates as a minor municipal discharger and is located in the non-tidal portion of an unnamed tributary to Indian Creek off Rt. 608, with two outfalls permitted to the tributary to Indian Creek. Outfall 001 is active and there are no plans to construct outfall 002. Outfall 001 is surrounded by a prohibited zone (a type of shellfish closure area) which was issued by VDH-DSS (shown as section C in VDH condemnations). While outfall 002 has not been built and contributes no fecal coliform bacteria to the stream, it is included in the waste load allocation (WLA) because it was included in the VPDES permit. The Kilmarnock WWTP has a design flow of 0.5 million gallon per day (MGD) and is permitted for total chlorine residual, a surrogate for fecal coliform bacterial limits of geometric mean 200 MPN/100 milliliters. If outfall 002 is constructed and begins actively discharging, it is understood that outfall 001 is to be taken offline. Outfalls 001 and 002 should not be in operation simultaneously as the Design Flow of 0.5 MGD is the permitted design in the permit for a single outfall. The WLA assigned in this TMDL report for the Kilmarnock WWTP allows for the operation of one outfall with a maximum design flow of 0.5 MGD. The WLA calculations are available in Table 5.16.

The Kilmarnock WWTP reported sewer overflows at the plant for the months of March, May, and November of 2007. This time frame is included within the study period was not during the time when BST samples were being taken. The facility's Discharge Monitoring Report (DMR) did not show any exceedences of their permit for fecal coliform during the sampling time frame.

### **Dymer Creek**

There is one active seafood general permit by Dymer Creek Seafood (VAG524007) which has two outfalls (001, 002) to Georges Cove, a tributary to Dymer Creek. There is one active storm water general permit operated by the Ocran Boat Shop, Inc. (VAR051153) which has one outfall, 001, to Georges Cove.

### **Tabbs Creek**

There are no DEQ permitted dischargers within Tabbs Creek.

### **Antipoison Creek**

There is one active seafood general permit by Pride of Virginia Seafood & Bait Company (VAG524039) which has three outfalls (001, 002, and 003) to Antipoison Creek.

**Table 4.1 Permitted Point Sources in Indian, Dymmer, Tabbs, and Antipoison Creeks and Tributaries**

Stream Name	Facility Name	VPDES Permit Number	Outfalls	Permit Type	Permitted for Fecal Coliform Control	Design Flow (MGD)
UT to Indian Creek	Kilmarnock Waste Water Treatment Plant	VA0020788	001, 002	Municipal Minor	YES	0.5
Georges Cove (tributary to Dymmer Creek)	Dymmer Creek Seafood	VAG5240007	001, 002	Seafood General	NO	N/A
Georges Cove (tributary to Dymmer Creek)	Ocran Boat Shop	VAR051153	001	Storm Water General	NO	N/A
Antipoison Creek	Pride of Virginia Seafood & Bait Co.	VAG524039	001, 002, 003	Seafood General	NO	N/A

**B. Non-Point Source**

Non-point sources of fecal coliform do not have one discharge point but may occur over the entire length of the receiving water. Fecal coliform bacteria deposited on the land surface can build up over time. During rain events, surface runoff transports water and sediment to waterways. Sources of fecal coliform bacteria include grazing livestock, concentrated animal feeding operations, manure application, and wildlife and pet excretion. Direct contribution to the waterway occurs when livestock or wildlife defecate into or immediately adjacent to receiving waters. Non-point source contributions from humans generally arise from failing septic systems and associated drain fields, moored or marina vessel discharges, storm water management facilities, pump station failures, and ex-filtration from sewer systems. Contributions from wildlife, both mammalian and avian, are natural conditions and may represent a background level of bacterial loading. It is therefore likely that human loading is due to failures in septic waste treatment systems and/or potential pollution from recreational vessel discharges.

The shoreline survey is used as a tool to identify non-point source contribution problems and locations. Figure 4.33 shows the results of the DSS sanitary shoreline surveys for Indian, Dymmer, and Tabbs dated 2004. The survey identified eleven onsite sewerage deficiencies, 9 boating sources, and 3 animal sources. Four of the onsite sewerage deficiencies and 1 animal deficiency has been corrected or has shown to not be contributive of pollution to the creek. Figure 4.34 shows the results of the DSS sanitary shoreline survey for Antipoison and Davenport Creeks. The survey identified 8 onsite sewerage deficiencies, 5 boating sources, and 1 animal source. Six of the onsite sewerage deficiencies have been corrected or have shown to not be contributive of pollution to the creek. Copies of these surveys are included in Appendix A.

VDH-DSS conducts new Sanitary Surveys every 8 years for each of the growing areas. Corrected violations are updated on a regular basis however new deficiencies are only reported when a new survey has been completed.

**Wildlife & Livestock**

Livestock numbers in Table 4.2 were gathered through observations made by DEQ TMDL staff by traveling through watersheds and making head counts of livestock/pets which were visible from roads. We compared our numbers with those numbers given to us through citizen comments on livestock

Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL populations. The septic failure (Human) numbers in Table 4.2 were taken from the VDH-DSS Sanitary Surveys for Indian Dymer and Tabbs Creek in 2004, and the Antipoison and Davenport Sanitary Survey in 2001.

Calculations for population estimates of pets and wildlife are shown in Table 4.3. The method used to calculate these population estimates is found in Appendix B and data is supplied by VIMS and DGIF. Records provided by the Northumberland County Treasurer's office cited 2148 individual dog licenses and 77 kennel licenses sold in 2008 (as of 10/29/08). Records provided by the Lancaster County Treasurer's office cited 1100 individual dog licenses and 19 kennel licenses for 2007. These records are available upon request from the Northumberland and Lancaster Counties Treasurers' Offices.

**Table 4.2 Domestic Animals and Septic Systems *observed* contributing pollution for Indian, Dymer, Tabbs, and Antipoison Creeks** (Based on observations by TMDL staff and comments from public meetings. Sanitary violation numbers (Human) were taken from the VDH Sanitary Surveys)

<b>Fecal Coliform Sources</b>	<b>Indian Creek</b>
Cattle	15
Chickens	5
Human	3
<b>Fecal Coliform Sources</b>	<b>Dymer Creek</b>
Horses	4
Human	3
<b>Fecal Coliform Sources</b>	<b>Tabbs Creek</b>
Cattle	16
Horses	35
Human	5
<b>Fecal Coliform Sources</b>	<b>Antipoison &amp; Davenport Creeks</b>
Horses	15
Human	7

**Table 4.3 Pet and wildlife population *calculated estimates* for individual and collective watersheds (calculated values from sub-watersheds within Indian, Dymer, Tabbs, & Antipoison Creeks in Appendix B)**

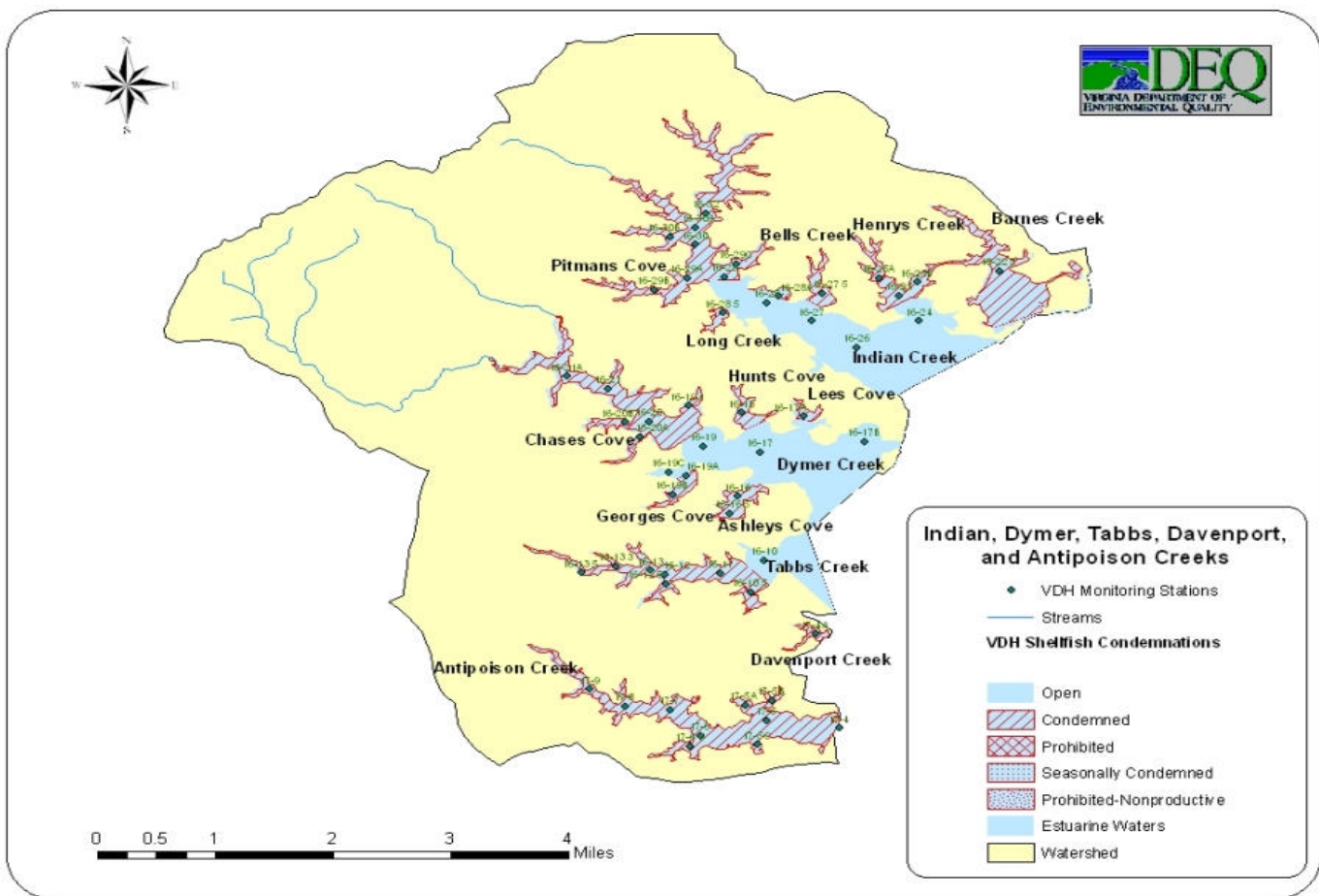
<b>Creek / County</b>	<b>Dogs</b>	<b>Deer</b>	<b>Raccoons</b>	<b>Ducks</b>	<b>Geese</b>
Indian Creek Lancaster	41	41	34	245	183
Indian Creek Northumberland	87	76	136	601	447
Dymer Creek Lancaster	162	171	211	403	345
Tabbs Creek Lancaster	43	45	49	239	178
Antipoison Creek Lancaster	75	77	89	316	235
<b>Total for Collective Watershed</b>	<b>408</b>	<b>410</b>	<b>520</b>	<b>1804</b>	<b>1388</b>

### **Biosolids & Poultry Litter Applications**

A search of permitted biosolids land-applications by land-applier within the 4 watersheds of Indian, Dymer, Tabbs, and Antipoison Creeks was made. No records of land-applied biosolids permits for farms within the 4 watersheds were found. Biosolids are also referred to as sewage sludge, which are the solid, semisolid, or liquid materials removed during the treatment of domestic sewage in a treatment facility. Biosolids include, but are not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings, and sewage sludge products. When properly treated and processed, sewage sludge become "biosolids" which can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth. Beginning January 1, 2008 the Virginia Department of Environmental Quality (DEQ) assumed regulatory oversight of all land application of biosolids.

A search was conducted for records of poultry litter transport and storage within Lancaster and Northumberland Counties. Two records from 2005 indicate 100 tons of poultry litter was delivered within the Chesapeake Bay watershed in the vicinity of Kilmarnock, Virginia. No other information is available however this information suggests that in 2005, 100 tons of poultry litter were destined for farmland applications within the Chesapeake Bay watershed which may have included the watersheds of Indian, Dymer, Tabbs, and Antipoison Creeks.

**Figure 4.1 Indian, Dymer, Tabbs, and Antipoison Creeks Stations and Condemnations Map**



Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

**Table 4.4 Water Quality Data Summary Indian Creek – Condemnation # 016-057**

\*Station 16-27 has exceeded the 90th Percentile one month in 24 years of sampling (in 10/2003). VDH-DSS has not listed this segment as condemned for this reason.\*

Creek Name	Station	Total Observations (1/mo)	Geometric Mean	Station Violates Geometric Standard: 14 MPN	90th Percentile	Station Violates 90th Percentile Standard: 49 MPN
Indian Creek Main Stem	16-26	262	5.30	No	28.78	No
	16-27	262	7.64	No	*52.36*	*Yes*
	16-28	263	8.03	No	43.45	No
	16-29	262	15.36	Yes	117	Yes
	16-30	264	28.21	Yes	453.09	Yes
	16-30A	264	39.73	Yes	484.86	Yes
	16-32	209	51.42	Yes	767.50	Yes
Barnes Creek	16-22_5	42	13.04	No	79.40	Yes
Henrys Creek	16-24	261	6.07	No	27.05	No
	16-25	259	11.20	No	71.78	Yes
	16-25A	44	13.00	No	69.03	Yes
	16-25B	44	8.87	No	62.37	Yes
Bells Creek	16-27_5	52	12.84	No	68.54	Yes
Long Creek	16-28_5	44	10.66	No	93.20	Yes
Pitmans Cove	16-29A	261	31.09	Yes	365.02	Yes
	16-29B	259	66.46	Yes	680.92	Yes
Waverly Cove	16-30B	262	58.05	Yes	854.23	Yes
Arthur Cove	16-29C	44	9.38	No	54.63	Yes

**Table 4.5 Water Quality Data Summary Dymer Creek – Condemnation # 016-024**

Creek Name	Station	Total Observations (1/mo)	Geometric Mean	Station Violates Geometric Standard: 14 MPN	90th Percentile	Station Violates 90th Percentile Standard: 49 MPN
Dymer Creek Main Stem	16-17	262	5.75	No	21.53	No
	16-19	207	8.30	No	46.06	No
	16-20	262	14.69	Yes	97.74	Yes
	16-21	262	32.03	Yes	280.51	Yes
	16-21A	254	66.26	Yes	606.66	Yes
Ashley Cove	16-16	261	11.09	No	66.10	Yes
	16-16_5	44	6.26	No	40.69	No
Lees Cove	16-17A	110	16.81	Yes	103.87	Yes
Rones Bay	16-17B	44	4.08	No	11.43	No
Hunts Cove	16-18	262	13.60	No	81.47	Yes
Georges Cove	16-19A	259	11.32	No	127.55	Yes
	16-19B	251	13.87	No	103.17	Yes
Poplar Neck Creek	16-19C	256	8.92	No	46.93	No
Johnsons Creek	16-19_1	262	26.87	Yes	341.73	Yes
Unnamed Cove	16-20A	45	23.82	Yes	236.48	Yes
Chases Cove	16-20B	42	19.09	Yes	173.64	Yes

**Table 4.6 Water Quality Data Summary Tabbs Creek –Condemnation # 016-133**

Creek Name	Station	Total Observations (1/mo)	Geometric Mean	Station Violates Geometric Standard: 14 MPN	90th Percentile	Station Violates 90th Percentile Standard: 49 MPN
Tabbs Creek	16-10	262	8.06	No	46.82	No
	16-10_5	44	9.00	No	49.65	Yes
	16-11	262	13.28	No	87.00	Yes
	16-12	259	37.82	Yes	349.15	Yes
	16-12_5	43	18.85	Yes	170.17	Yes
	16-13	257	63.18	Yes	553.19	Yes
	16-13_5	254	133.66	Yes	1015.53	Yes

**Table 4.7 Water Quality Data Summary Antipoison Creek – Condemnation # 017-188**

Creek Name	Station	Total Observations (1/mo)	Geometric Mean	Station Violates Geometric Standard: 14 MPN	90th Percentile	Station Violates 90th Percentile Standard: 49 MPN
Antipoison Creek Main Stem	17-3	118	3.92	No	9.03	No
	17-4	260	12.54	No	104.64	Yes
	17-5	260	8.66	No	45.67	No
	17-6	260	12.67	No	96.69	Yes
	17-7	260	14.91	Yes	86.70	Yes
	17-8	259	24.12	Yes	159.83	Yes
Un-named Cove North	17-5A	43	10.95	No	63.57	Yes
	17-5B	44	17.64	Yes	112.09	Yes
Un-named Cove South	17-5C	43	13.71	No	77.04	Yes
Davenport Creek	17-4A	79	27.25	Yes	283.89	Yes
Harpers Creek	17-6_5	44	10.94	No	85.20	Yes

Figure 4.2A

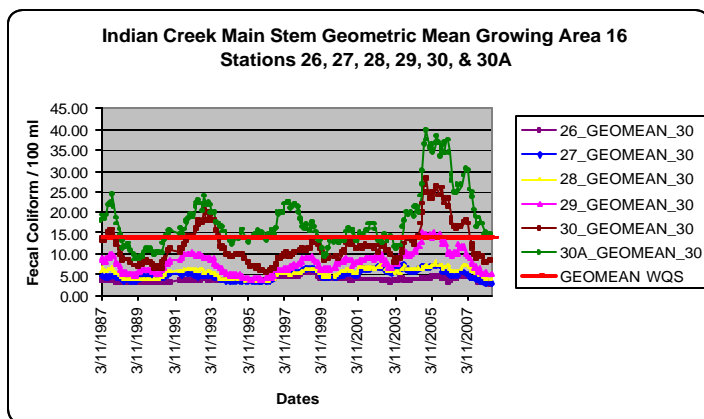


Figure 4.2B

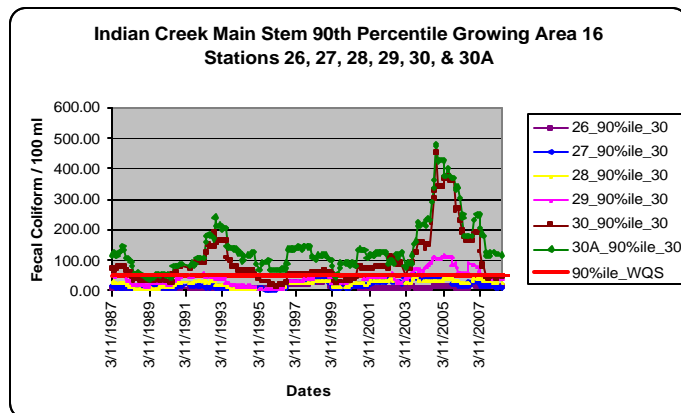


Figure 4.3A

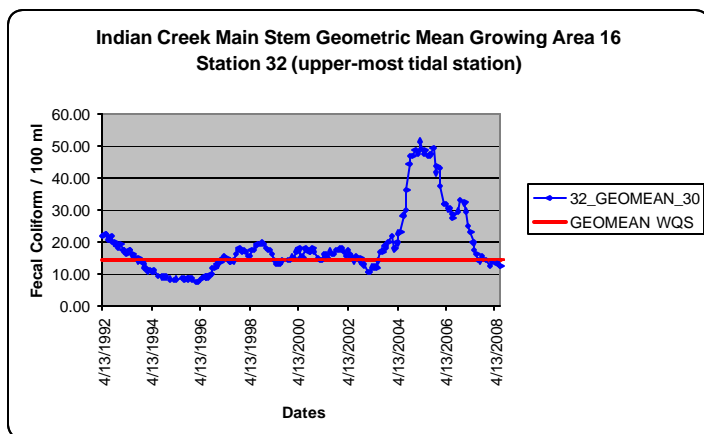


Figure 4.3B

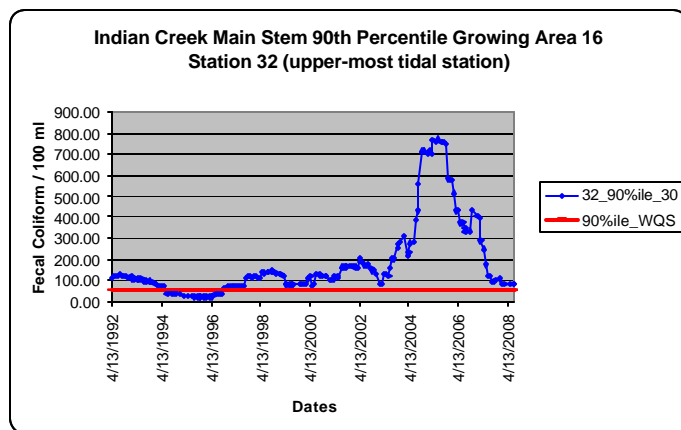


Figure 4.4A

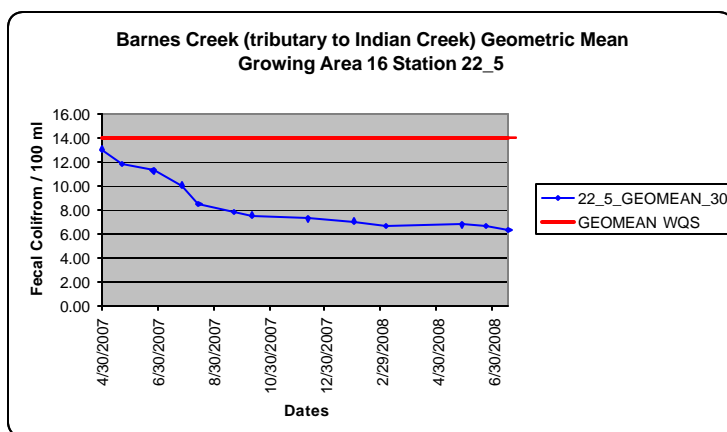


Figure 4.4B

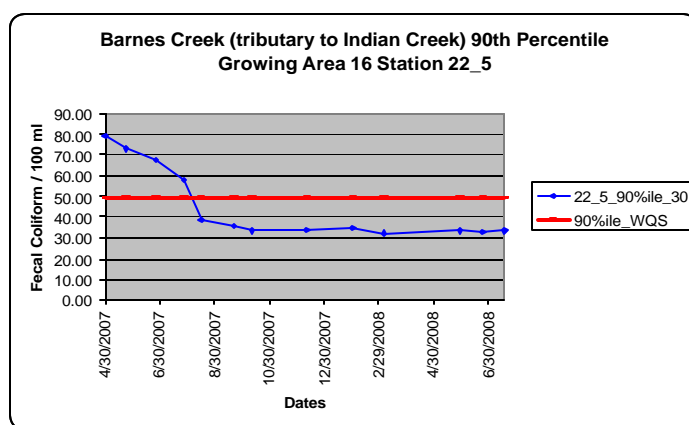




Figure 4.5A

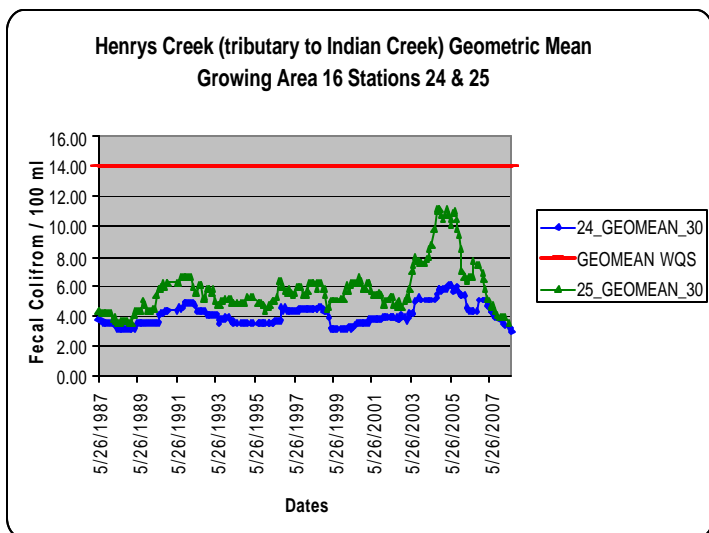


Figure 4.5B

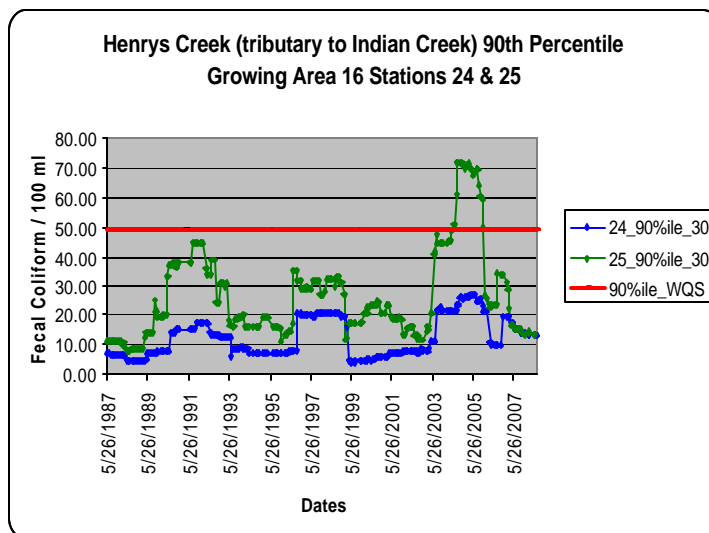


Figure 4.6A

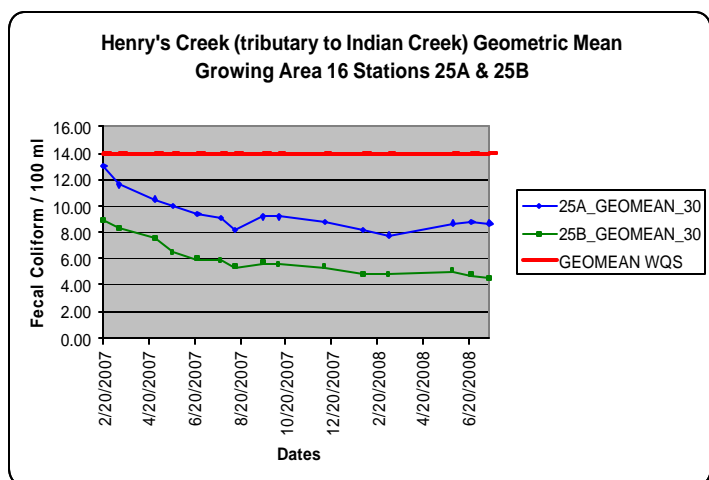


Figure 4.6B

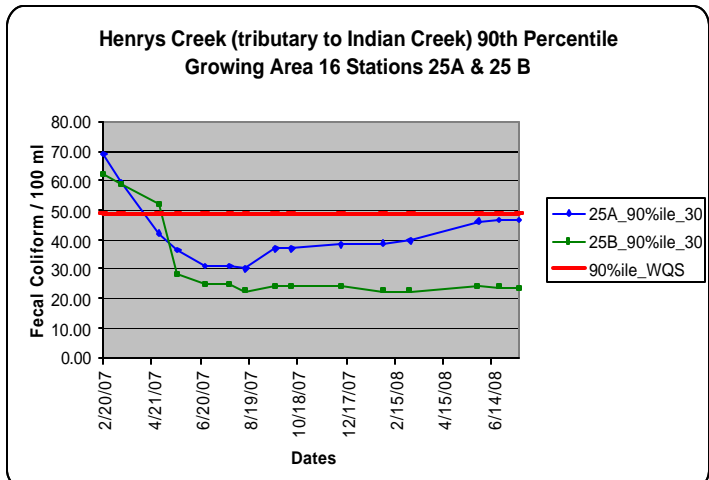


Figure 4.7A

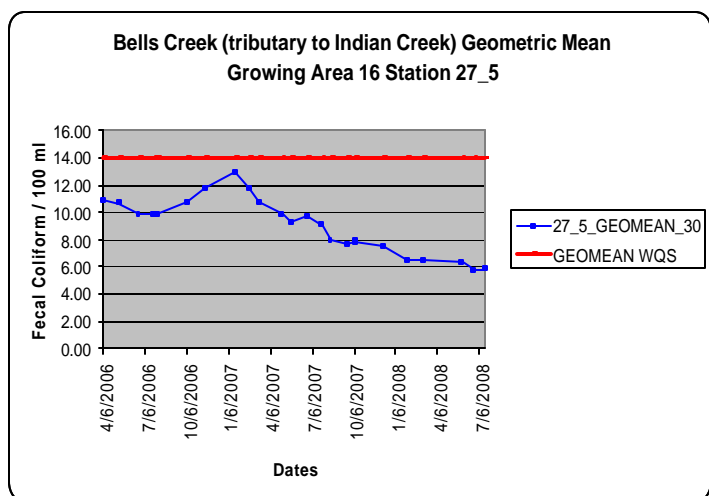


Figure 4.7B

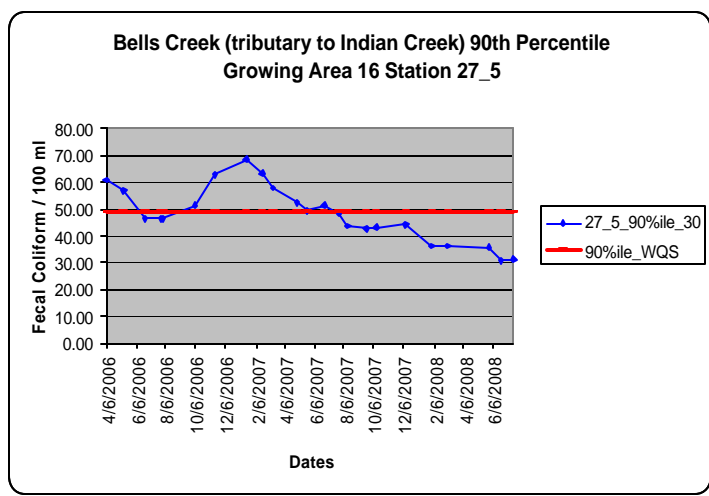


Figure 4.8A

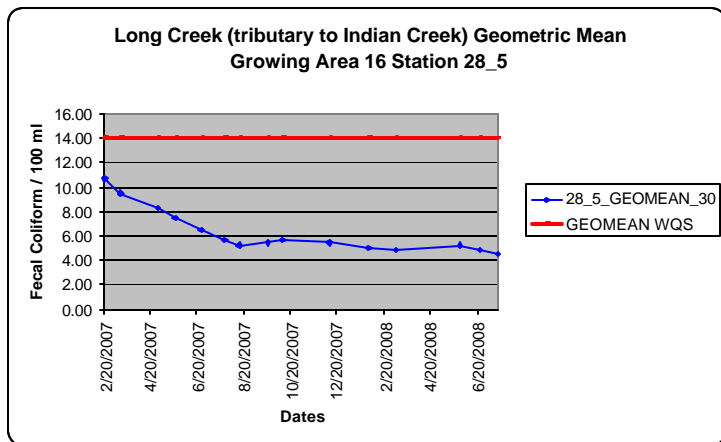


Figure 4.8B

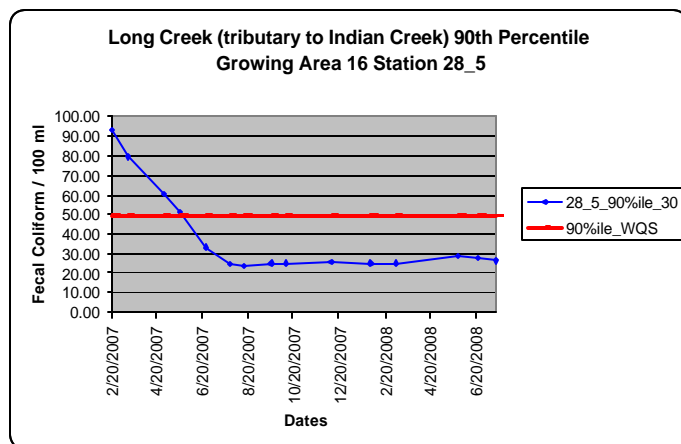


Figure 4.9A

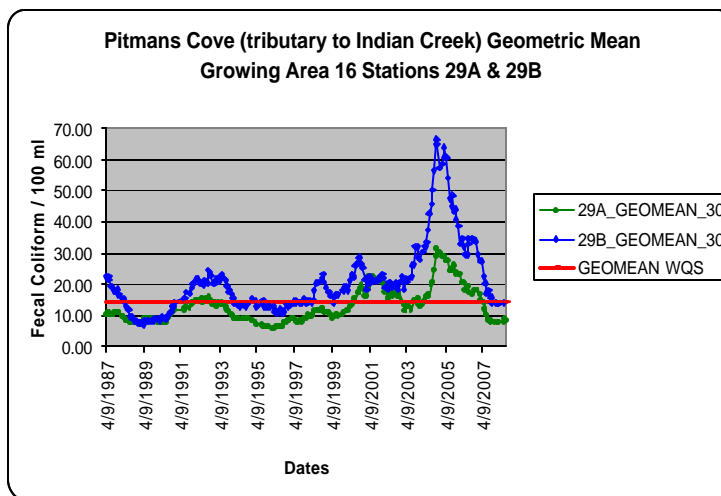


Figure 4.9B

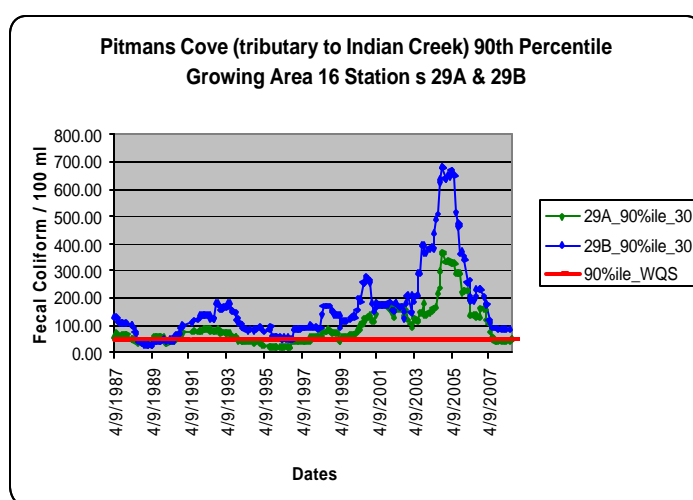


Figure 4.10A

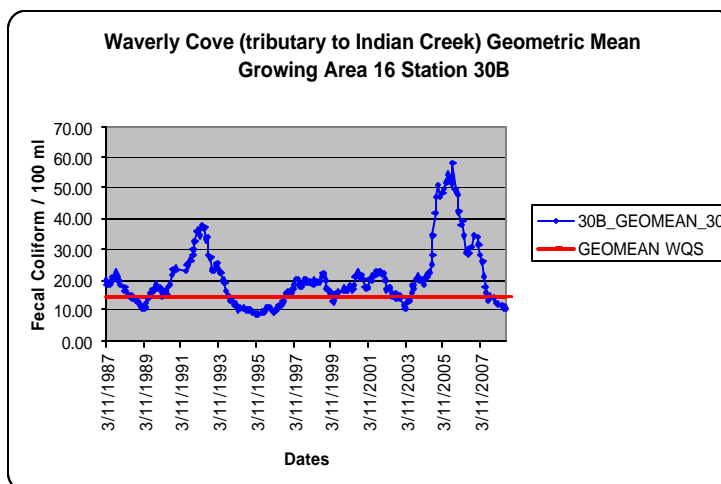


Figure 4.10B

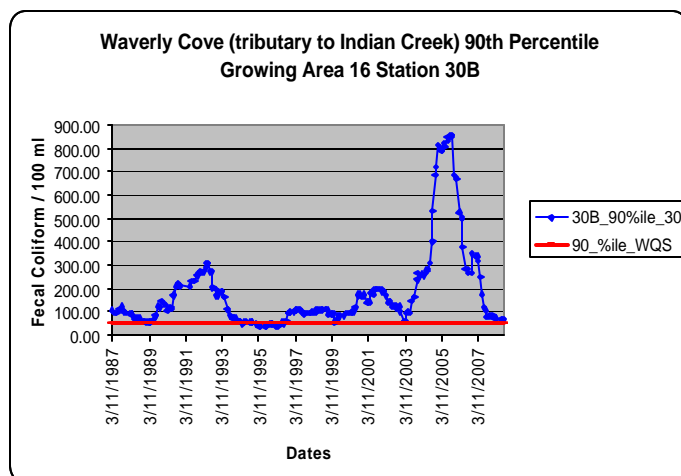


Figure 4.11A

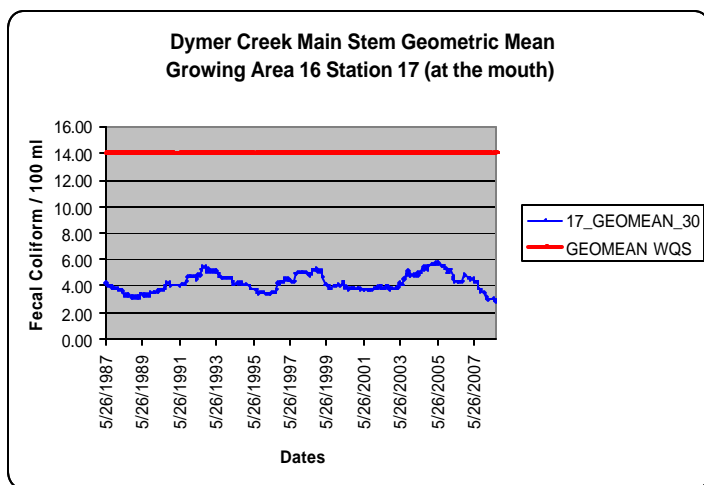


Figure 4.11B

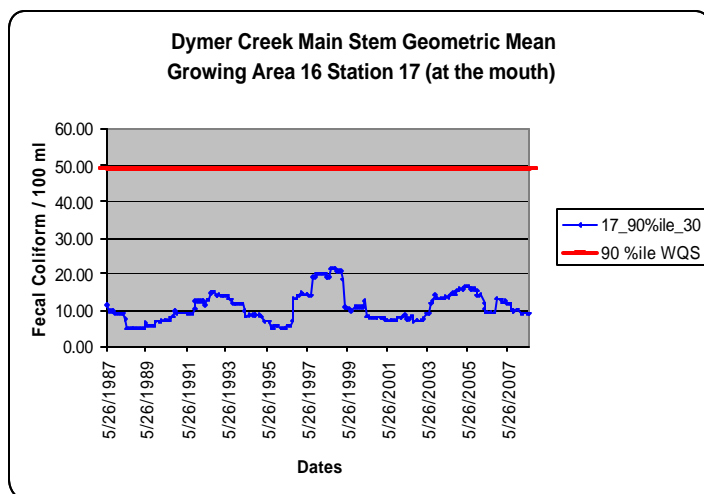


Figure 4.12A

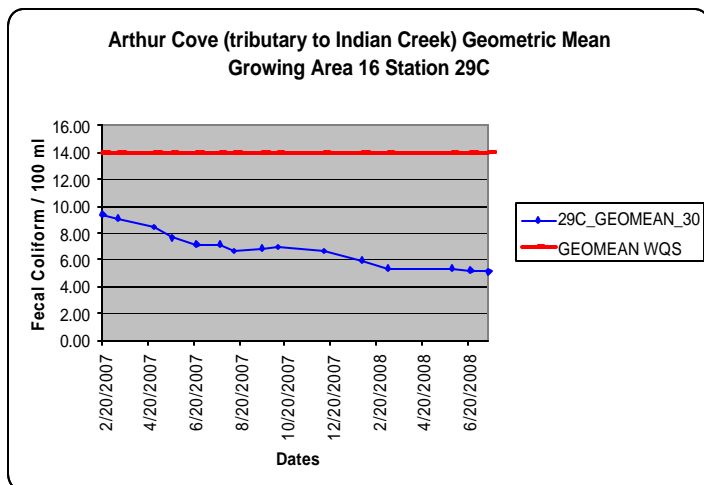


Figure 4.12B

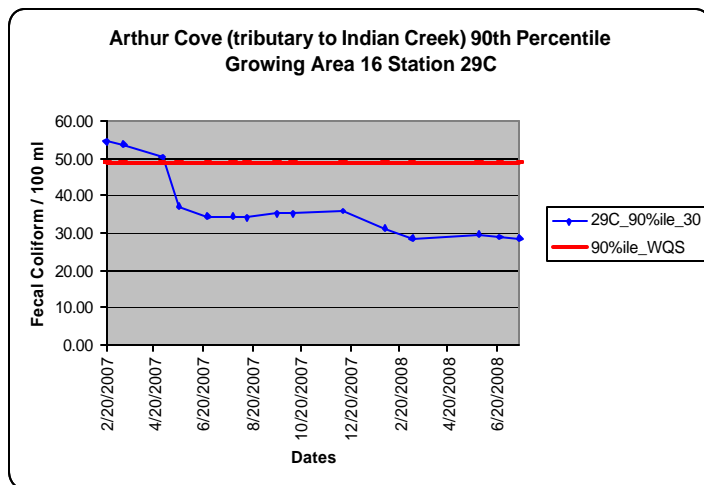
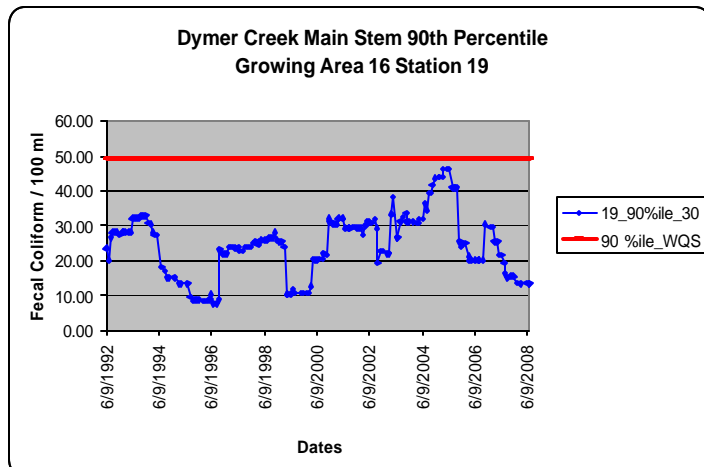
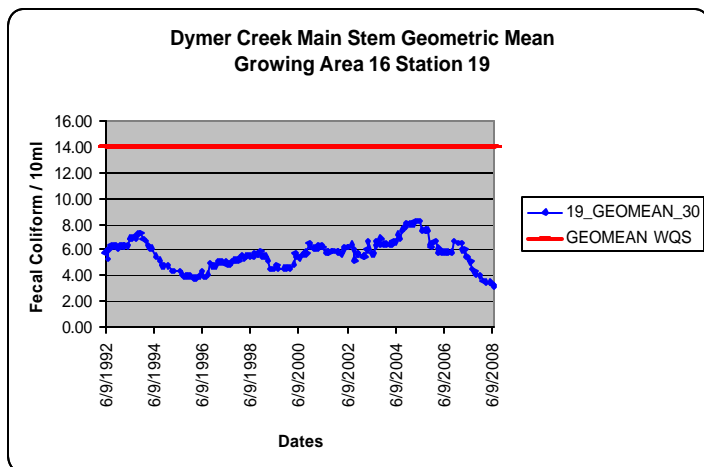


Figure 4.13A



Figure

4.13B

Figure 4.14A

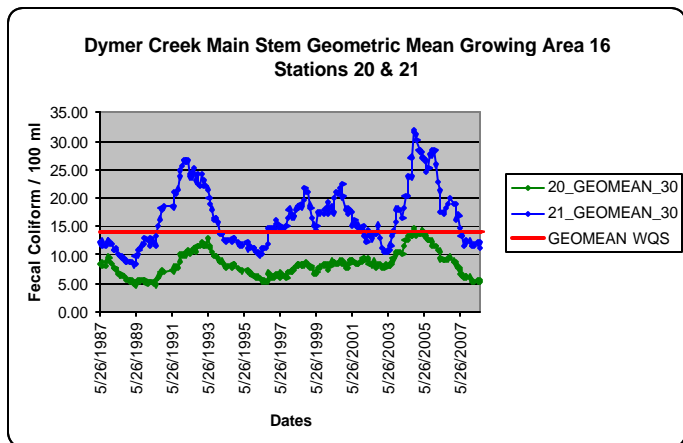


Figure 4.14B

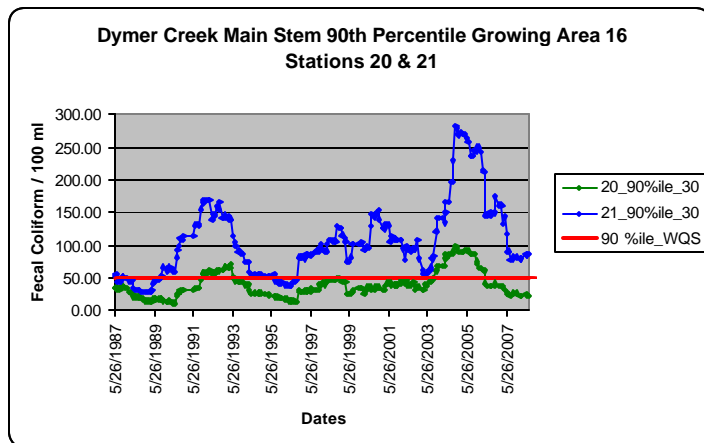


Figure 4.15A

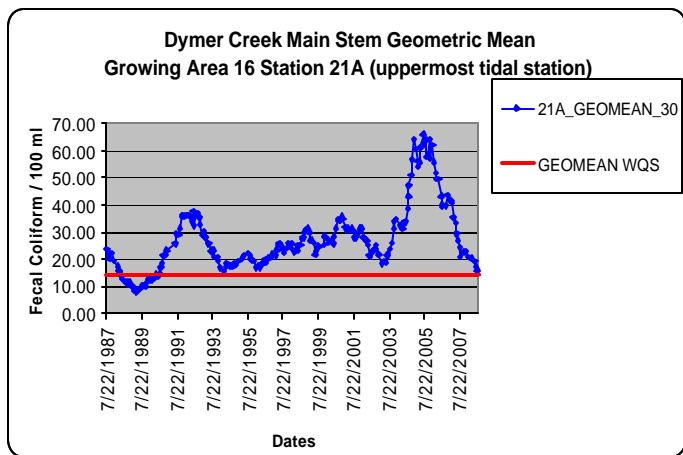


Figure 4.15B

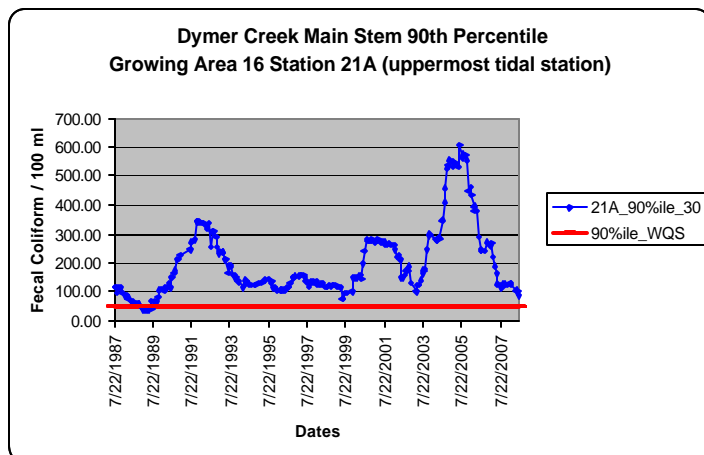
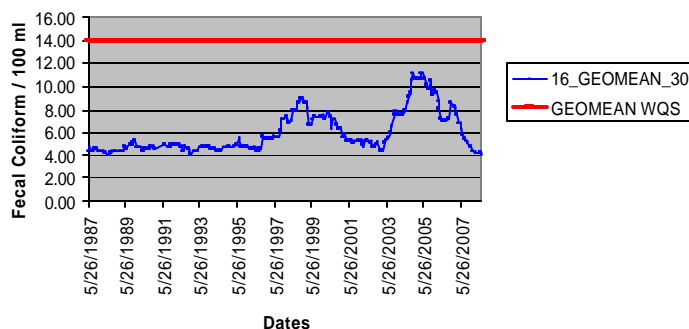


Figure 4.16A

Figure 4.16B

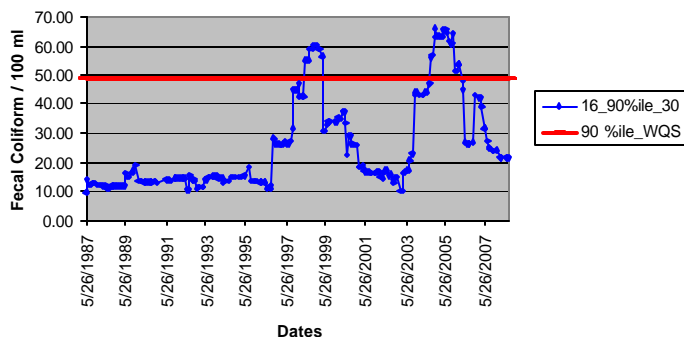
# Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

**Ashley Cove (tributary to Dymmer Creek) Geometric Mean  
Growing Area 16 Station 16 (mouth of creek)**



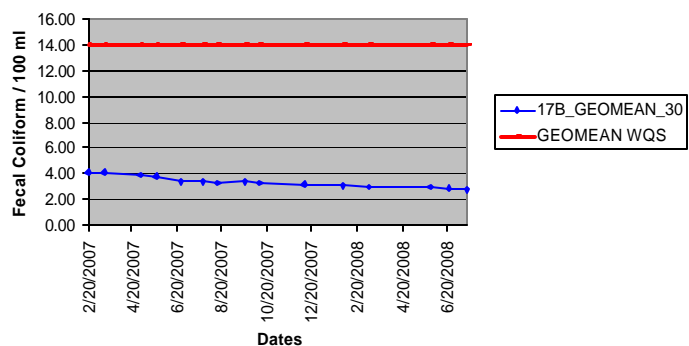
**Figure 4.17A**

**Ashley Cove (tributary to Dymmer Creek) 90th Percentile  
Growing Area 16 Station 16 (mouth of creek)**



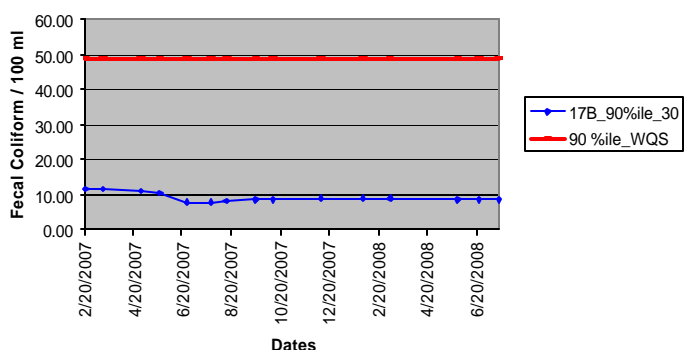
**Figure 4.17B**

**Rones Bay (tributary to Dymmer Creek) Geometric Mean  
Growing Area 16 Station 17B**



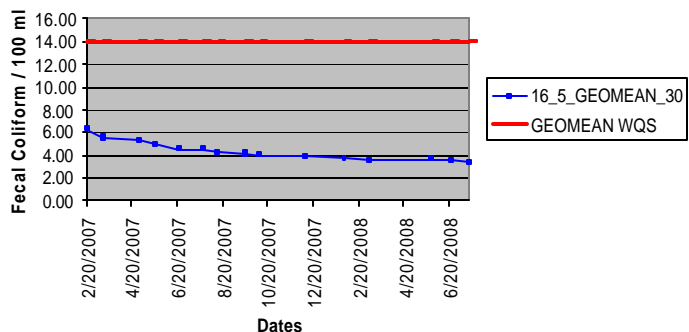
**Figure 4.18A**

**Rones Bay (tributary to Dymmer Creek) 90th Percentile  
Growing Area 16 Station 17B**



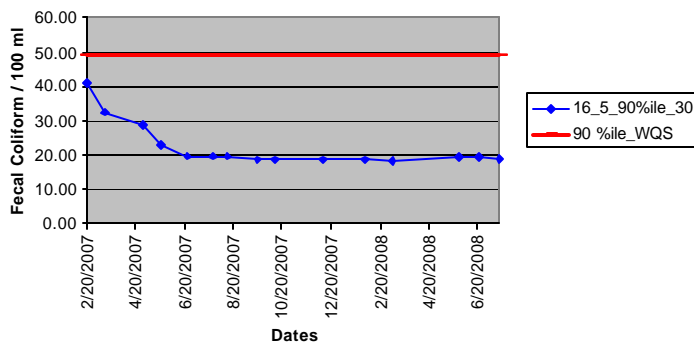
**Figure 4.18B**

**Ashley Cove (tributary to Dymmer Creek) Geometric Mean  
Growing Area 16 Station 16\_5 (upper reach)**



**Figure 4.19A**

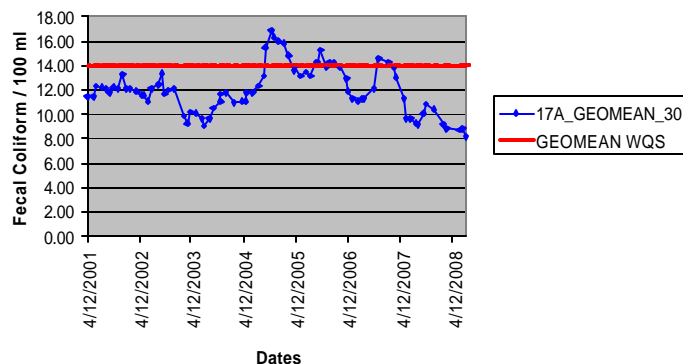
**Ashley Cove (tributary to Dymmer Creek) 90th Percentile  
Growing Area 16 Station 16\_5 (upper reach)**



**Figure 4.19B**

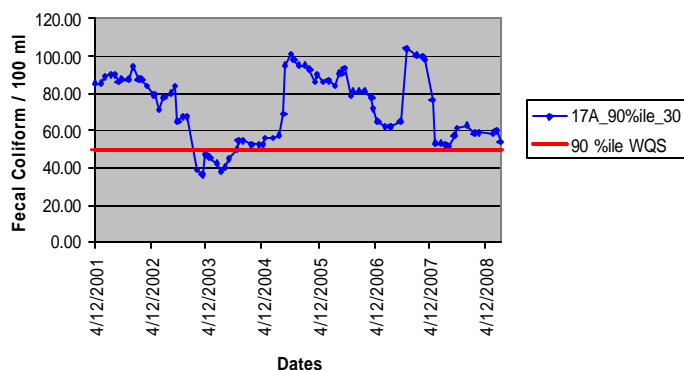
# Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL

**Lees Cove (tributary to Dymer Creek) Geometric Mean  
Growing Area 16 Station 17A**



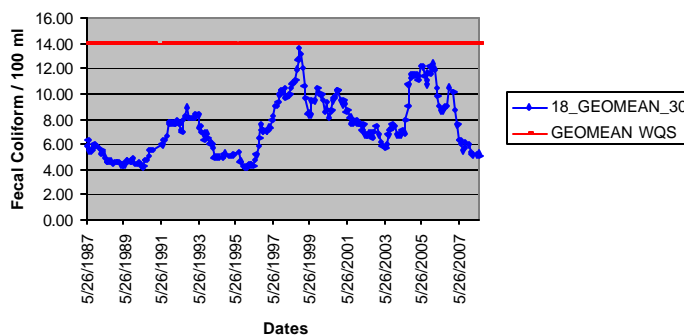
**Figure 4.20A**

**Lees Cove (tributary to Dymer Creek) 90th Percentile  
Growing Area 16 Station 17A**



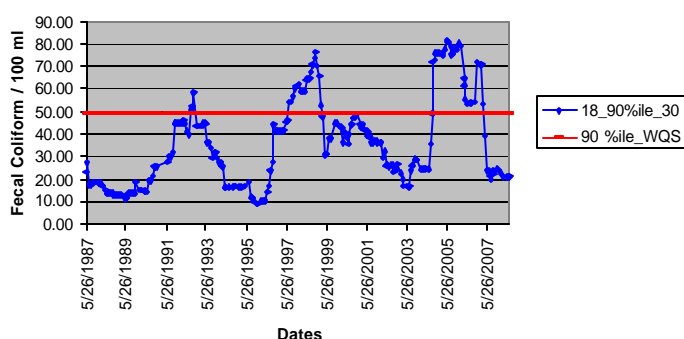
**Figure 4.20B**

**Hunts Cove (tributary to Dymer Creek) 90th Percentile  
Growing Area 16 Station 18**



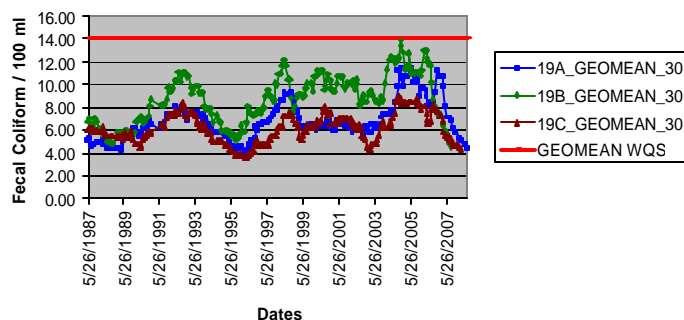
**Figure 4.21A**

**Hunt's Cove (tributary to Dymer Creek) 90th Percentile  
Growing Area 16 Station 18**



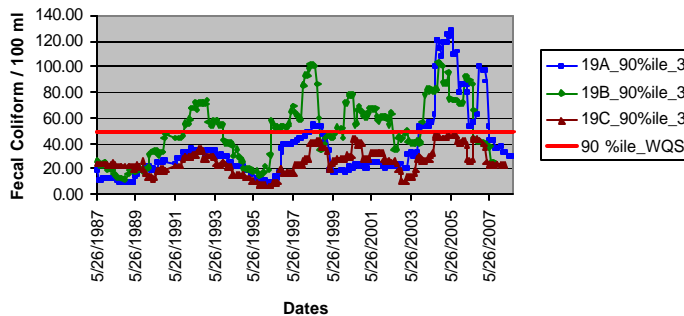
**Figure 4.21B**

**Georges Cove and Poplar Neck  
(tributaries to Dymer Creek) Geometric Mean  
Growing Area 16 Stations 19A & 19B, and 19C**



**Figure 4.22A**

**Georges Cove and Poplar Neck Creek  
(tributaries to Dymer Creek) 90th Percentile  
Growing Area 16 Stations 19A & 19B, and 19C**



**Figure 4.22B**

**Johnson Cove (tributary to Dymer Creek) Geometric Mean  
Growing Area 16 Station 19\_1**

**Johnson Cove (tributary to Dymer Creek) 90th Percentile  
Growing Area 16 Station 19\_1**

Figure 4.23A

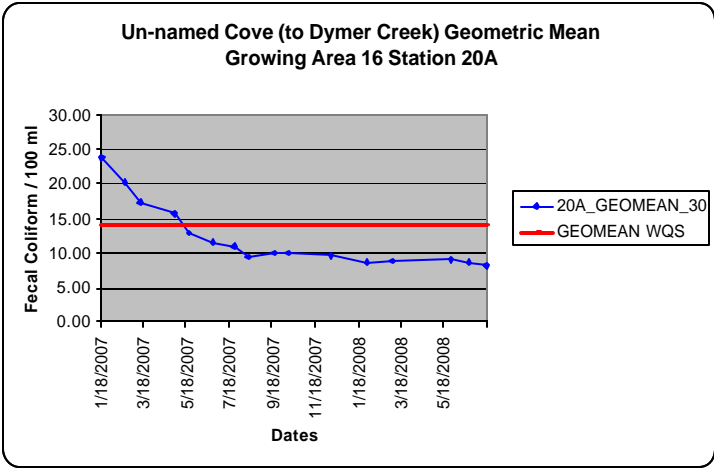


Figure 4.23B

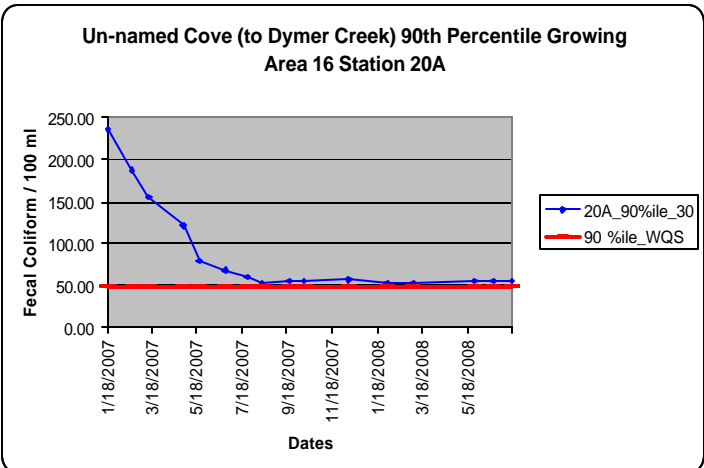


Figure 4.24A

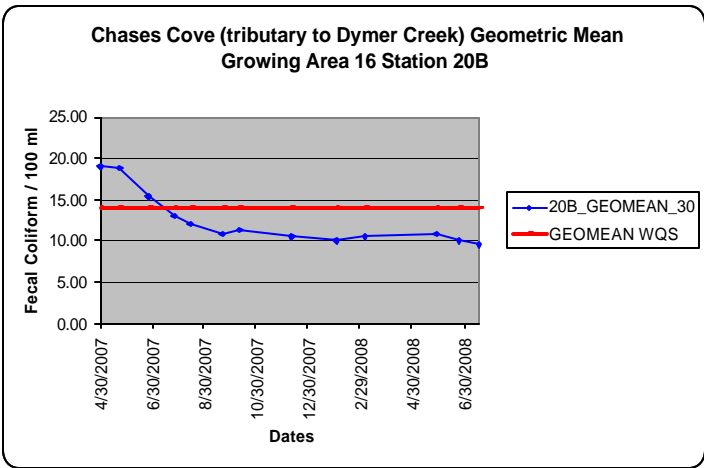


Figure 4.24B

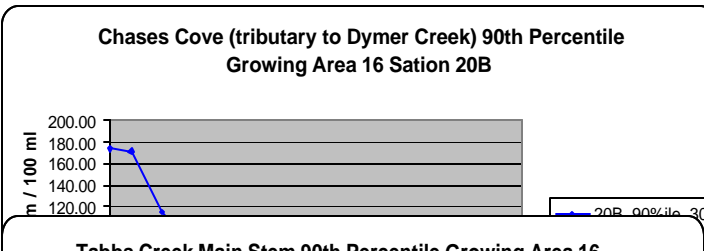
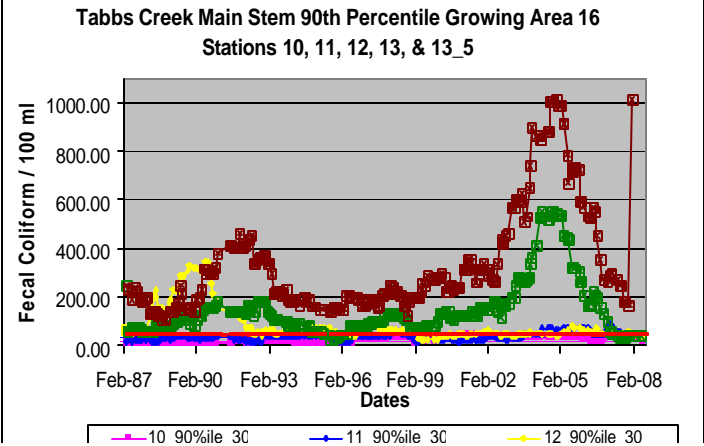


Figure 4.25A

Figure 4.25B



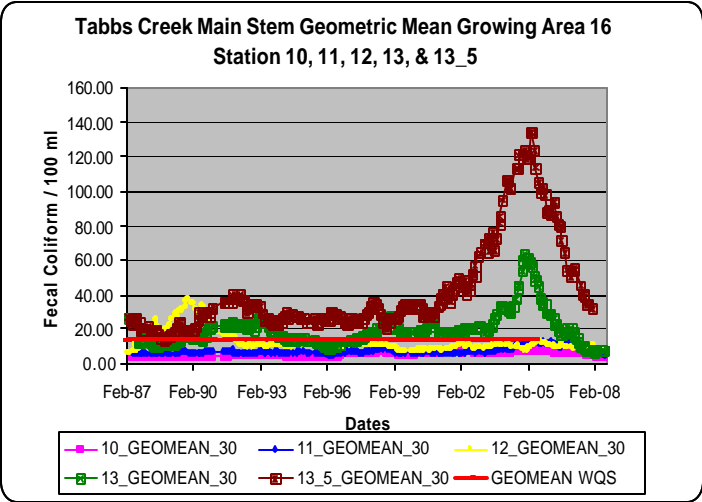




Figure 4.26A

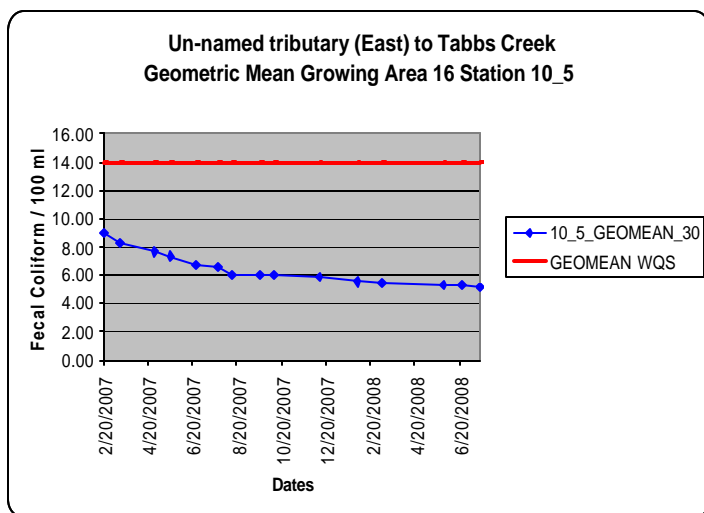


Figure 4.26B

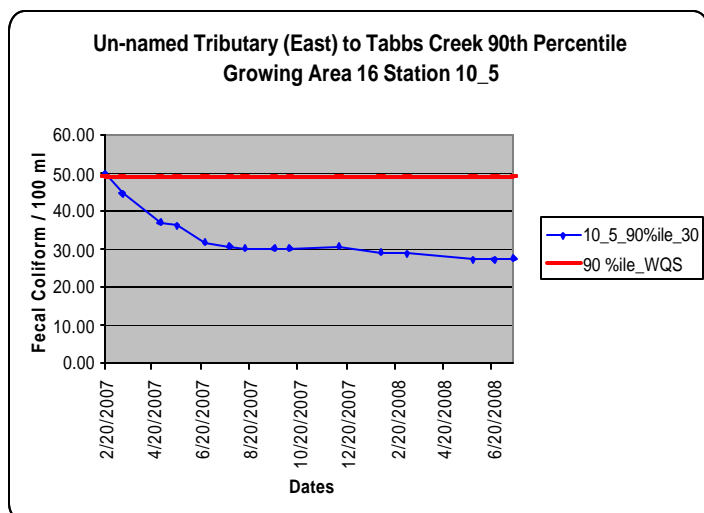


Figure 4.27A

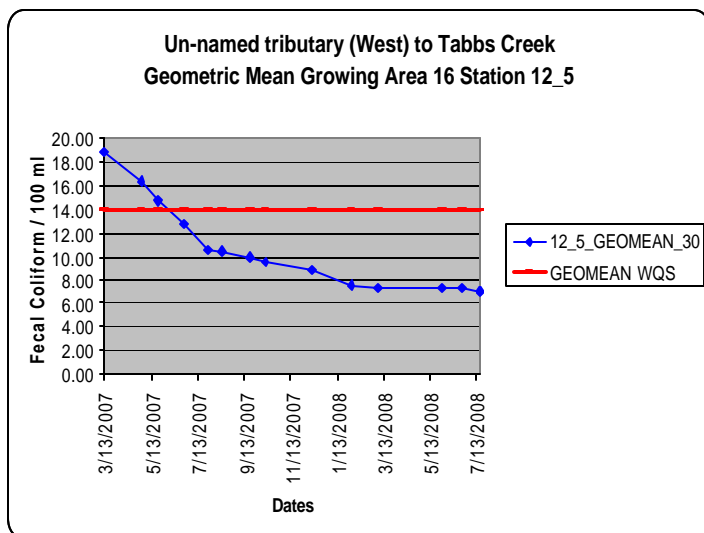


Figure 4.27B

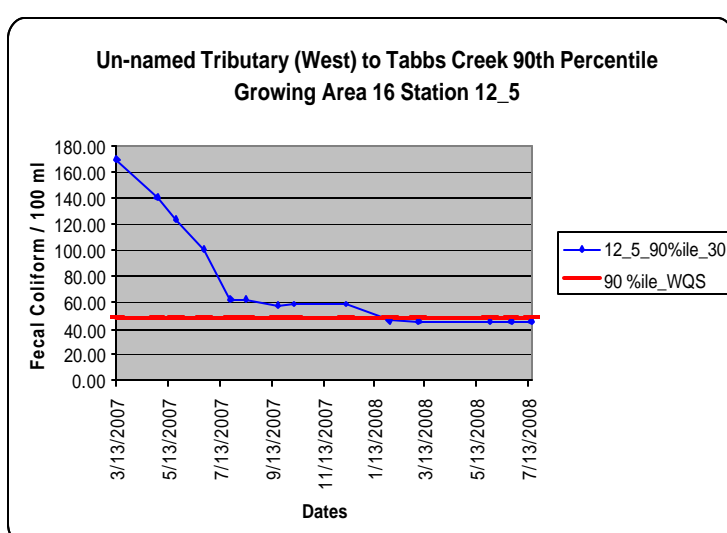


Figure 4.28A

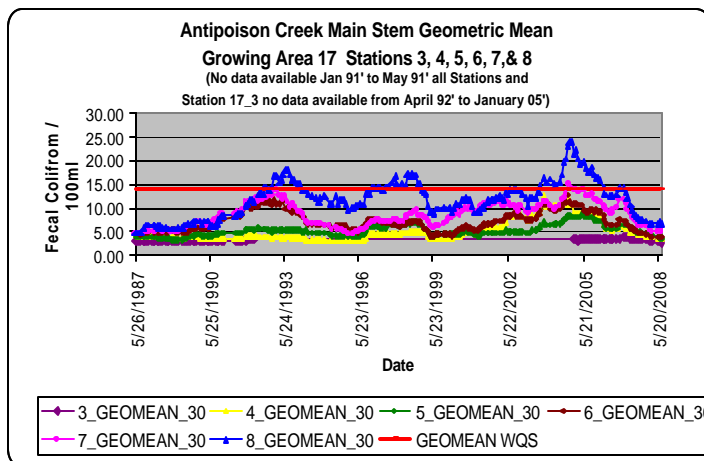


Figure 4.28B

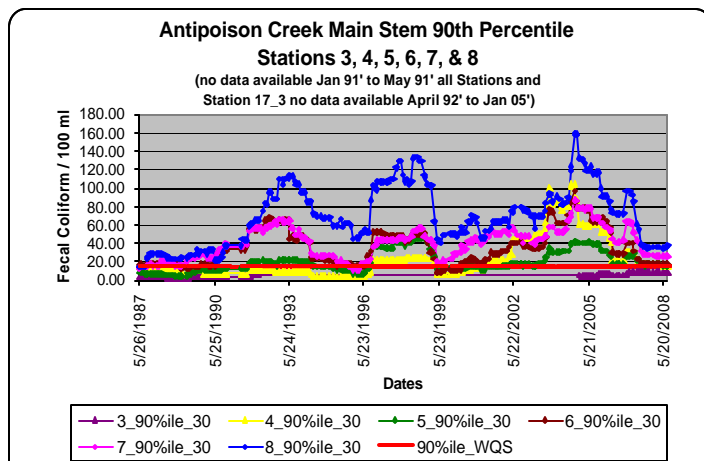


Figure 4.29A

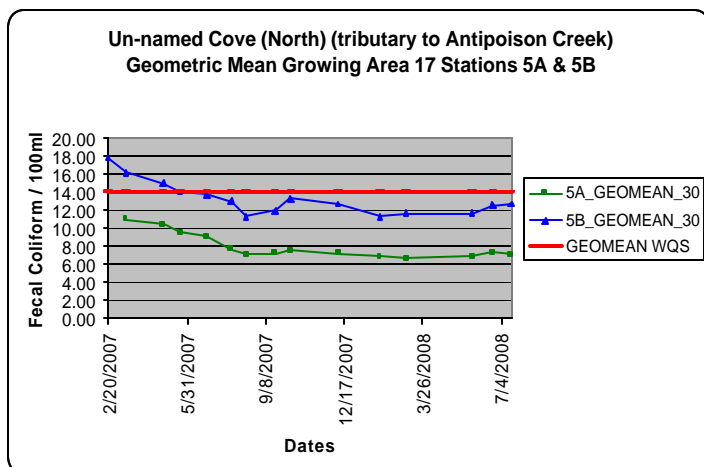


Figure 4.29B

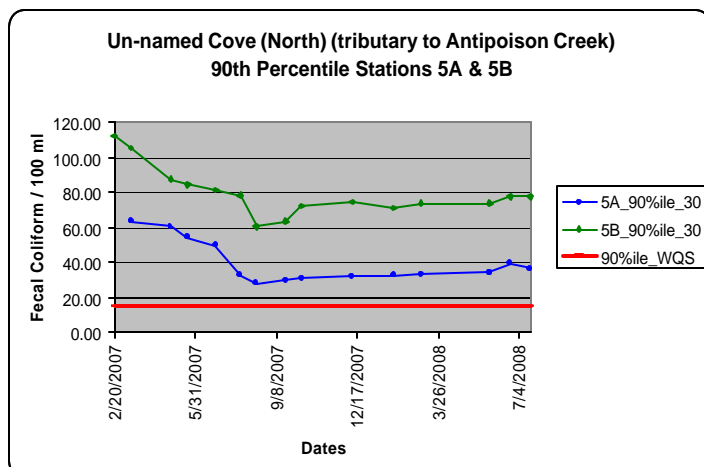


Figure 4.30A

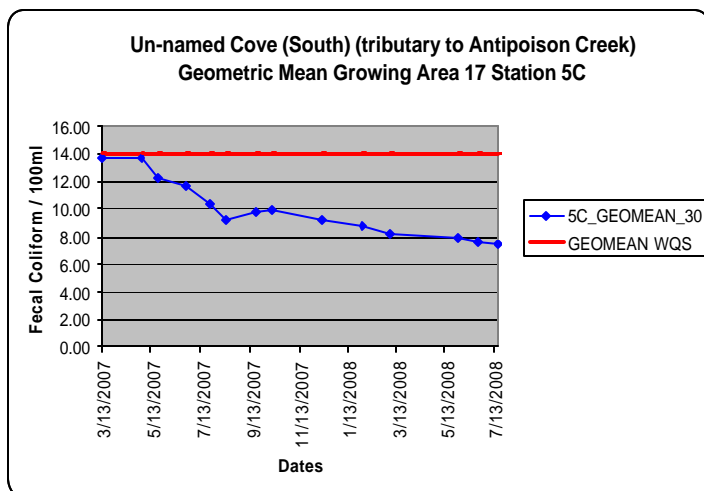


Figure 4.30B

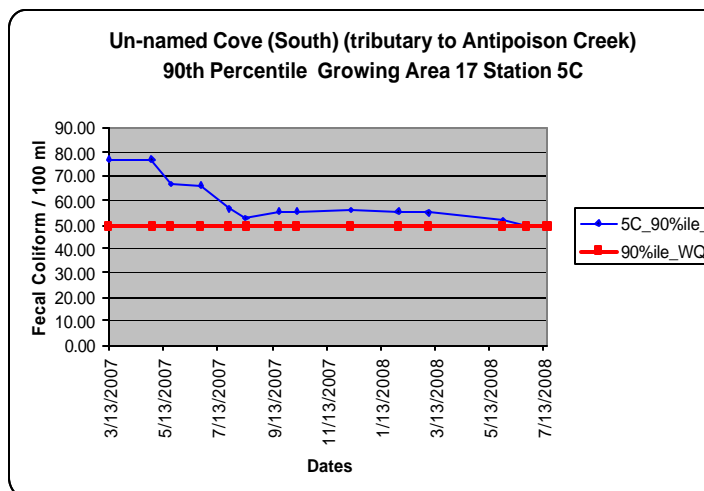


Figure 4.31A

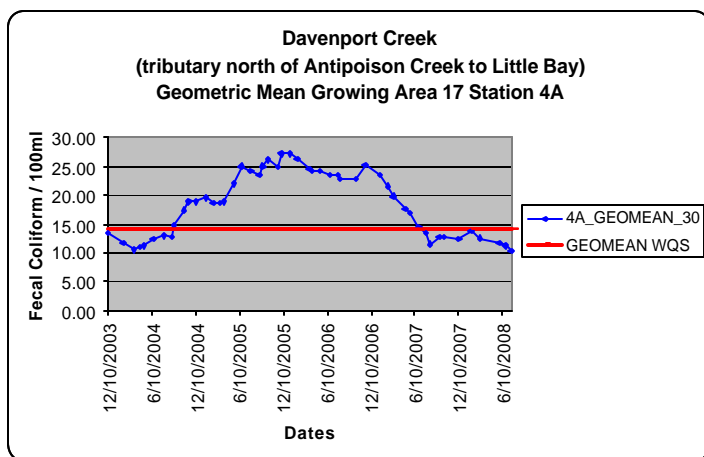


Figure 4.31B

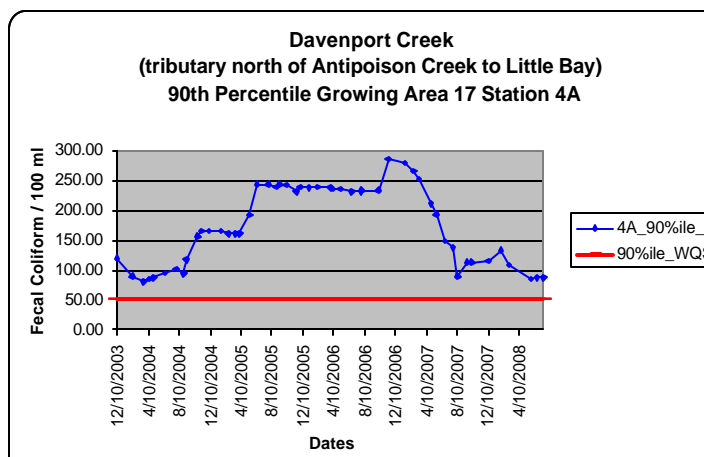


Figure 4.32A

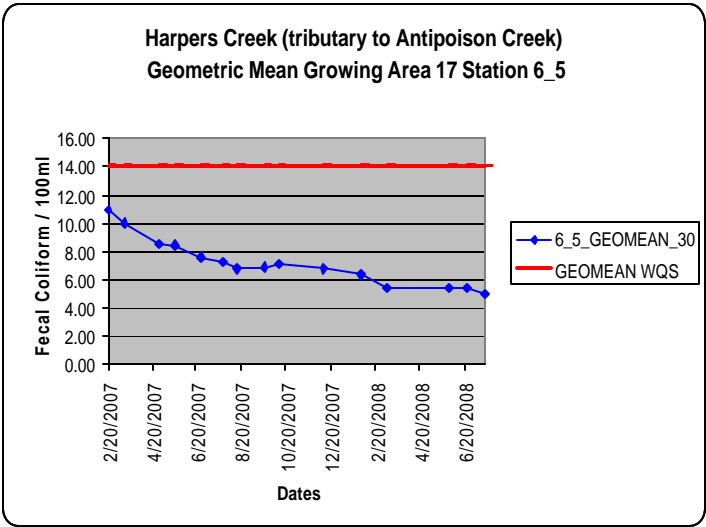
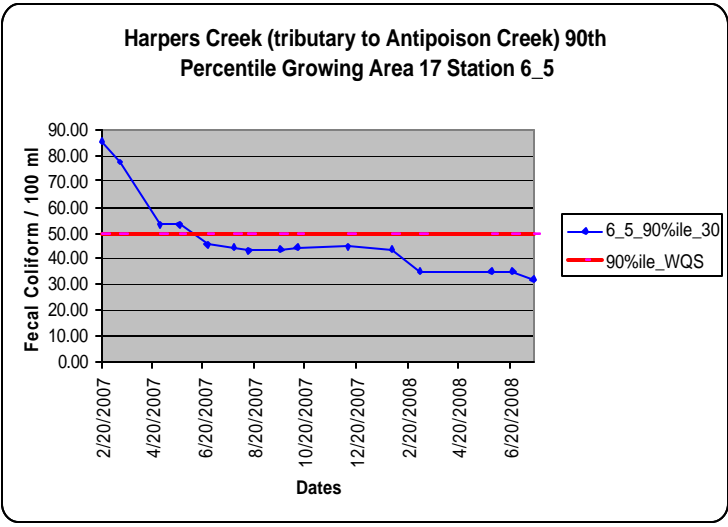
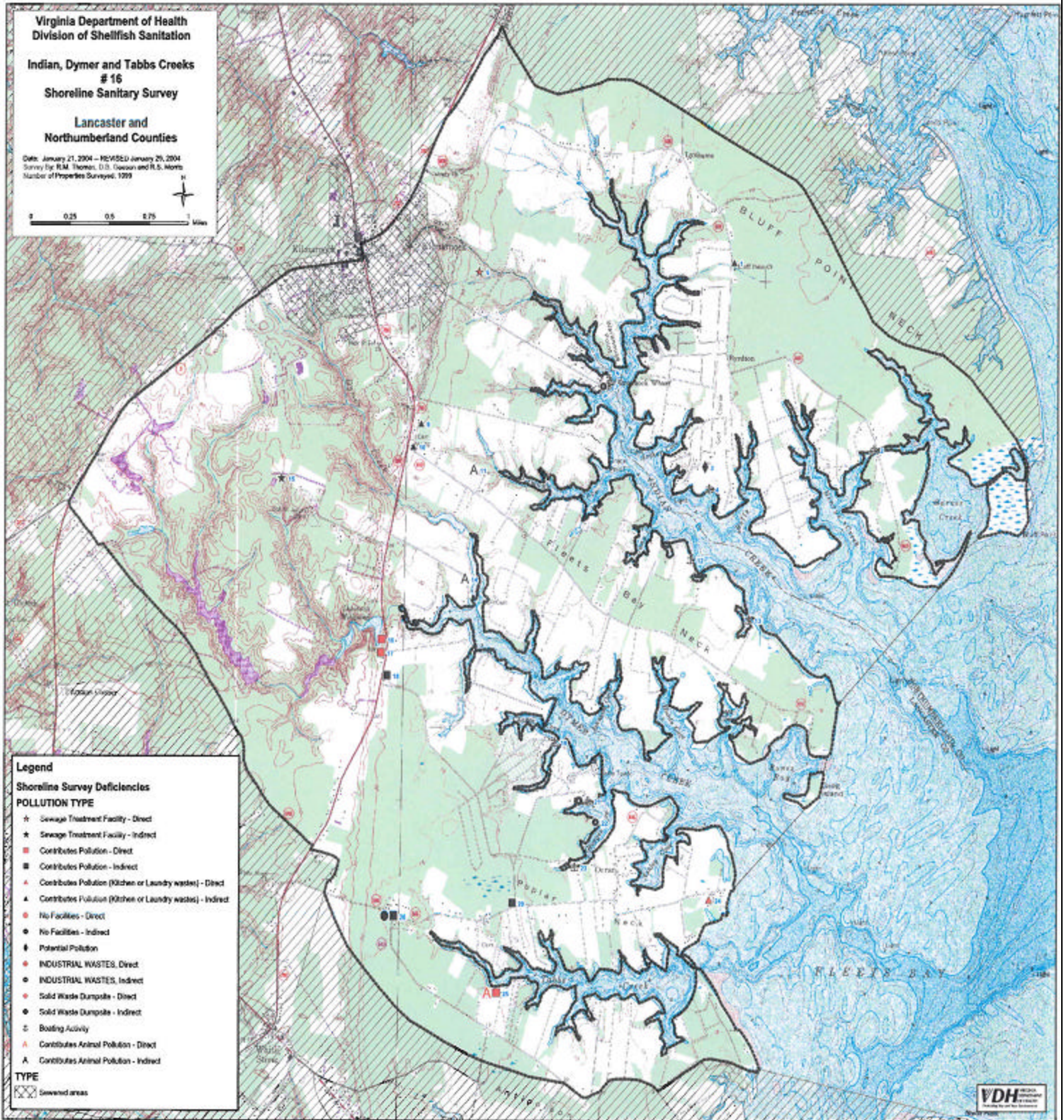


Figure 4.32B



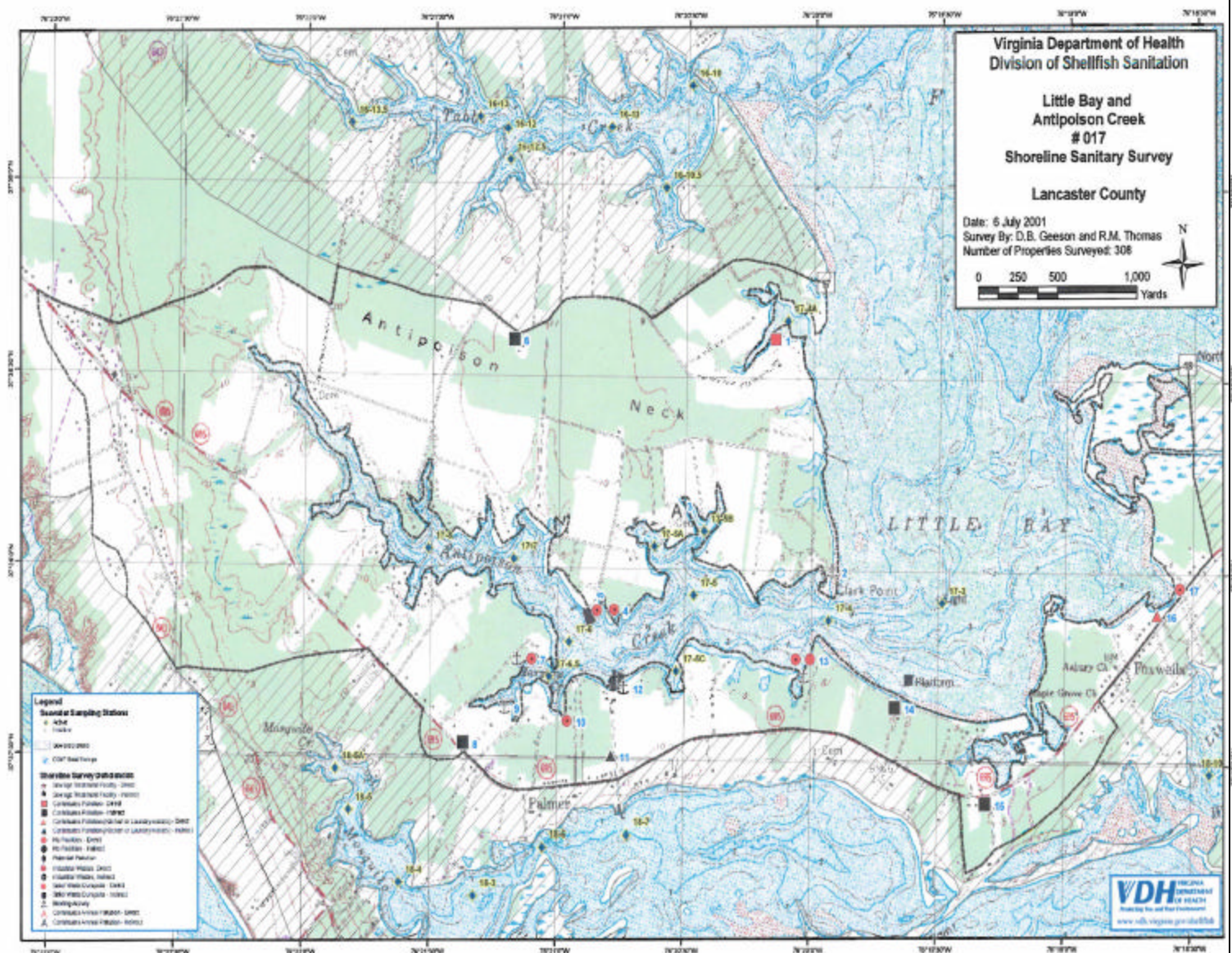


**Figure 4.33 Virginia Department of Health – Department of Shellfish Sanitation Shoreline Sanitary Survey Map for Indian, Dyer, and Tabbs Creeks**





**Figure 4.34 Virginia Department of Health – Department of Shellfish Sanitation Shoreline Sanitary Survey Map for Antipoison and Davenport Creeks**



## 4.4 Bacterial Source Tracking

Bacterial Source tracking is used to identify sources of fecal contamination from human as well as domestic and wild animals. The BST method used in Virginia is based on the premise that *Escherichia coli* (*E. Coli*) found in human, domestic animal, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Analysis (ARA) uses fecal streptococcus or *E. coli* and patterns of antibiotic resistance for separation of sources of the bacterial contribution. The BST analysis used for this TMDL classified the bacteria into one of four source categories: human, pets, livestock, and wildlife. However, BST analysis is an inexact technique that is still under evaluation and error exists in correctly assigning *E. coli* isolates to the appropriate fecal sources. BST is a general tool for making a broad determination of bacterial source, therefore BST percentages should not be considered precise.

The BST sampling period was October 2004 through September 2005. The target sampling interval was once monthly. The location of BST stations are chosen by VDH. Table 4.8 shows the summary of all BST monitoring stations for Indian Creek, Dymer Creek, Tabbs Creek, and Antipoison Creek growing areas. Table 4.9 shows BST for Indian Creek station 16-29B and Table 4.10 shows BST for Indian Creek station 16-30. Table 4.11 shows BST for Dymer Creek station 16-19B and Table 4.12 shows BST for Dymer Creek station 16-21A. Table 4.13 shows the BST for Tabbs Creek at station 16-13. Table 4.14 shows the BST results for Antipoison Creek at station 17-8. There were no BST monitoring in the other named creeks because they were added to the TMDL after the BST sampling period. For each station where BST was collected, BST percentages were weighted by the number of isolates, concentration, and volume. Thus the higher the number of isolates, concentration, and volume; the more weight an individual sample was given in calculating the BST source percentages. Table 4.15 shows the weighted average BST for Indian Creek, Table 4.16 shows the weighted average BST for Dymer Creek, Table 4.17 gives the weighted average BST for Tabbs Creek, and Table 4.18 shows the weighted average BST for Antipoison Creek. The respective BST pie charts for these four Creeks are shown in Figures 4.35 through 4.38.

The BST shows that for Indian Creek the largest percentage source was human (65%), followed by wildlife at 23%, pet at 9%, and livestock at 3%. In Dymer Creek, pet was the dominant source at 41%, followed by human at 26%, wildlife at 22%, and livestock at 11%. Tabbs Creek BST analysis showed wildlife at 62% as the major source of *E. coli*, with human at 18%, livestock at 12%, and pet at 8%. Finally, Antipoison Creek had a dominant source of human at 66%, wildlife at 30%, and pet and livestock both at 2% each. These values were used as a tool to help determine the source allocations in deriving the Total Maximum Daily Loads for Indian, Dymer, Tabbs, and Antipoison Creeks.

**Table 4.8 Summary of Bacterial Source Tracking samples for Indian, Dymer, Tabbs, and Antipoison Creeks**

Station ID	Growing Area	HUP	County	Impairment	# Plates Received
16-29B	016	C01	Lancaster	Pittman's Cove Trib to Indian Creek	12
16-30	016	C01	Lancaster	Indian Creek Georges Cove	12
16-19B	016	C01	Lancaster	Trib to Dymer Creek	10
16-21A	016	C01	Lancaster	Dymer Creek	12
16-13	016	C01	Lancaster	Tabbs Creek	12
17-8	017	C01	Lancaster	Antipoison Creek	12

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates.

**Table 4.9 Bacterial Source Tracking results for Indian Creek at Station 16-29B**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
16-29B	10/21/2004	24	120	<b>17%</b>	<b>25%</b>	<b>25%</b>	<b>33%</b>
16-29B	11/8/2004	17	15	12%	<b>41%</b>	<b>41%</b>	6%
16-29B	12/8/2004	24	39	8%	<b>71%</b>	4%	<b>17%</b>
16-29B	1/19/2005	24	2.9	<b>79%</b>	<b>17%</b>	4%	0%
16-29B	2/17/2005	7	2.9	14%	14%	0%	72%
16-29B	3/21/2005	14	2.9	<b>21%</b>	0%	<b>21%</b>	<b>58%</b>
16-29B	4/4/2005	24	75	<b>17%</b>	<b>75%</b>	0%	8%
16-29B	5/17/2005	24	3.6	<b>83%</b>	<b>17%</b>	0%	0%
16-29B	6/29/2005	24	43	8%	<b>12%</b>	<b>17%</b>	<b>63%</b>
16-29B	7/27/2005	17	2.9	<b>88%</b>	0%	12%	0%
16-29B	8/29/2005	19	2.9	<b>47%</b>	<b>16%</b>	0%	<b>37%</b>
16-29B	9/13/2005	19	9.1	<b>21%</b>	<b>26%</b>	0%	<b>53%</b>

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates

**Table 4.10 Bacterial Source Tracking results for Indian Creek at Station 16-30.**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
16-30	10/21/2004	24	1200	<b>25%</b>	<b>71%</b>	0%	4%
16-30	11/8/2004	14	15	<b>93%</b>	0%	0%	7%
16-30	12/8/2004	24	23	<b>29%</b>	<b>67%</b>	4%	0%
16-30	1/19/2005	12	2.9	<b>25%</b>	<b>58%</b>	17%	0%
16-30	2/17/2005	12	3.6	<b>58%</b>	17%	8%	17%
16-30	3/21/2005	6	2.9	0%	17%	0%	83%
16-30	4/4/2005	24	93	<b>21%</b>	<b>75%</b>	4%	0%
16-30	5/17/2005	15	9.1	<b>47%</b>	<b>53%</b>	0%	0%
16-30	6/29/2005	24	23	0%	<b>54%</b>	<b>17%</b>	<b>29%</b>
16-30	7/27/2005	15	2.9	13%	<b>27%</b>	0%	<b>60%</b>
16-30	8/29/2005	15	3.6	<b>40%</b>	<b>33%</b>	7%	<b>20%</b>
16-30	9/13/2005	11	23	<b>27%</b>	9%	9%	<b>55%</b>

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates



**Table 4.11 Bacterial Source Tracking results for Dymer Creek at Station 16-19B.**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
16-19B	10/21/2004	24	23	<b>38%</b>	<b>62%</b>	0%	0%
16-19B	11/8/2004	24	9.1	<b>21%</b>	<b>17%</b>	<b>25%</b>	<b>37%</b>
16-19B	12/8/2004	4	15	0%	75%	0%	25%
16-19B	2/17/2005	7	23	0%	14%	0%	86%
16-19B	4/4/2005	24	9.1	<b>17%</b>	<b>79%</b>	4%	0%
16-19B	5/17/2005	24	3.6	<b>41%</b>	0%	<b>21%</b>	<b>38%</b>
16-19B	6/29/2005	24	240	0%	8%	12%	<b>80%</b>
16-19B	7/27/2005	6	3	17%	0%	0%	83%
16-19B	8/29/2005	10	3.6	<b>30%</b>	10%	0%	<b>60%</b>
16-19B	9/13/2005	2	2.9	50%	0%	0%	50%

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates.

**Table 4.12 Bacterial Source Tracking results for Dymer Creek at Station 16-21A.**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
16-21A	10/21/2004	15	460	<b>33%</b>	<b>67%</b>	0%	0%
16-21A	11/8/2004	24	75	<b>33%</b>	4%	<b>33%</b>	<b>30%</b>
16-21A	12/8/2004	24	150	<b>63%</b>	<b>25%</b>	8%	4%
16-21A	1/19/2005	12	9.1	<b>42%</b>	<b>42%</b>	16%	0%
16-21A	2/17/2005	14	9.1	7%	<b>43%</b>	<b>21%</b>	<b>29%</b>
16-21A	3/21/2005	4	2.9	0%	0%	50%	50%
16-21A	4/4/2005	24	23	8%	<b>88%</b>	0%	4%
16-21A	5/17/2005	24	43	<b>42%</b>	4%	4%	<b>50%</b>
16-21A	6/29/2005	24	460	4%	8%	<b>21%</b>	<b>67%</b>
16-21A	7/27/2005	18	43	6%	6%	0%	<b>88%</b>
16-21A	8/29/2005	24	93	<b>54%</b>	<b>38%</b>	0%	8%
16-21A	9/13/2005	17	3.6	<b>18%</b>	<b>53%</b>	0%	<b>29%</b>

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates.

**Table 4.13 Bacterial Source Tracking results for Tabbs Creek at Station 16-13.**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
16-13	10/21/2004	24	1100	<b>68%</b>	<b>12%</b>	12%	8%
16-13	11/8/2004	22	93	<b>14%</b>	<b>77%</b>	9%	0%
16-13	12/8/2004	22	93	<b>50%</b>	<b>36%</b>	0%	<b>14%</b>
16-13	1/19/2005	24	93	<b>55%</b>	<b>12%</b>	<b>33%</b>	0%
16-13	2/17/2005	24	15	0%	<b>62%</b>	0%	<b>38%</b>
16-13	3/21/2005	24	3	<b>33%</b>	0%	<b>63%</b>	4%
16-13	4/4/2005	24	3.6	<b>12%</b>	<b>84%</b>	4%	0%
16-13	5/17/2005	8	3	12%	0%	50%	38%
16-13	6/29/2005	14	9.1	7%	14%	14%	<b>65%</b>
16-13	7/27/2005	8	3.6	50%	25%	0%	25%
16-13	8/29/2005	15	2.9	<b>67%</b>	0%	<b>20%</b>	13%
16-13	9/13/2005	9	3.6	22%	<b>78%</b>	0%	0%

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates.

**Table 4.14 Bacterial Source Tracking results for Antipoison Creek at Station 17-8.**

Station ID	Date of Sample	Number of Isolates	<i>E. coli</i> Concentration	Wildlife	Human	Livestock	Pet
17-8	10/21/2004	24	460	<b>29%</b>	<b>71%</b>	0%	0%
17-8	11/8/2004	9	9.1	<b>89%</b>	11%	0%	0%
17-8	12/8/2004	22	23	<b>45%</b>	<b>23%</b>	9%	<b>23%</b>
17-8	1/19/2005	8	9.1	76%	12%	12%	0%
17-8	2/17/2005	15	9.1	<b>20%</b>	0%	<b>53%</b>	<b>27%</b>
17-8	3/21/2005	20	2.9	<b>50%</b>	<b>45%</b>	5%	0%
17-8	4/4/2005	24	9.1	<b>25%</b>	<b>67%</b>	8%	0%
17-8	5/17/2005	24	3.6	<b>71%</b>	4%	<b>17%</b>	8%
17-8	6/29/2005	20	43	<b>25%</b>	<b>65%</b>	5%	5%
17-8	7/27/2005	7	3.6	71%	0%	0%	29%
17-8	8/29/2005	22	2.9	0%	0%	0%	<b>100%</b>
17-8	9/13/2005	9	3.6	<b>44%</b>	<b>44%</b>	0%	12%

**BOLD** type indicates a statistically significant value.

NVI – No viable isolates.

**Table 4.15 Isolate, Concentration, and Volume Weighted Average BST for Indian Creek by Type**

<b>Condemnation Area</b>	<b>Livestock</b>	<b>Wildlife</b>	<b>Human</b>	<b>Pet</b>
<b>057 Indian Creek</b>	<b>3%</b>	<b>23%</b>	<b>65%</b>	<b>9%</b>

**Table 4.16 Isolate, Concentration, and Volume Weighted Average BST for Dyer Creek by Type**

<b>Condemnation Area</b>	<b>Livestock</b>	<b>Wildlife</b>	<b>Human</b>	<b>Pet</b>
<b>024 Dyer Creek</b>	<b>11%</b>	<b>22%</b>	<b>26%</b>	<b>41%</b>

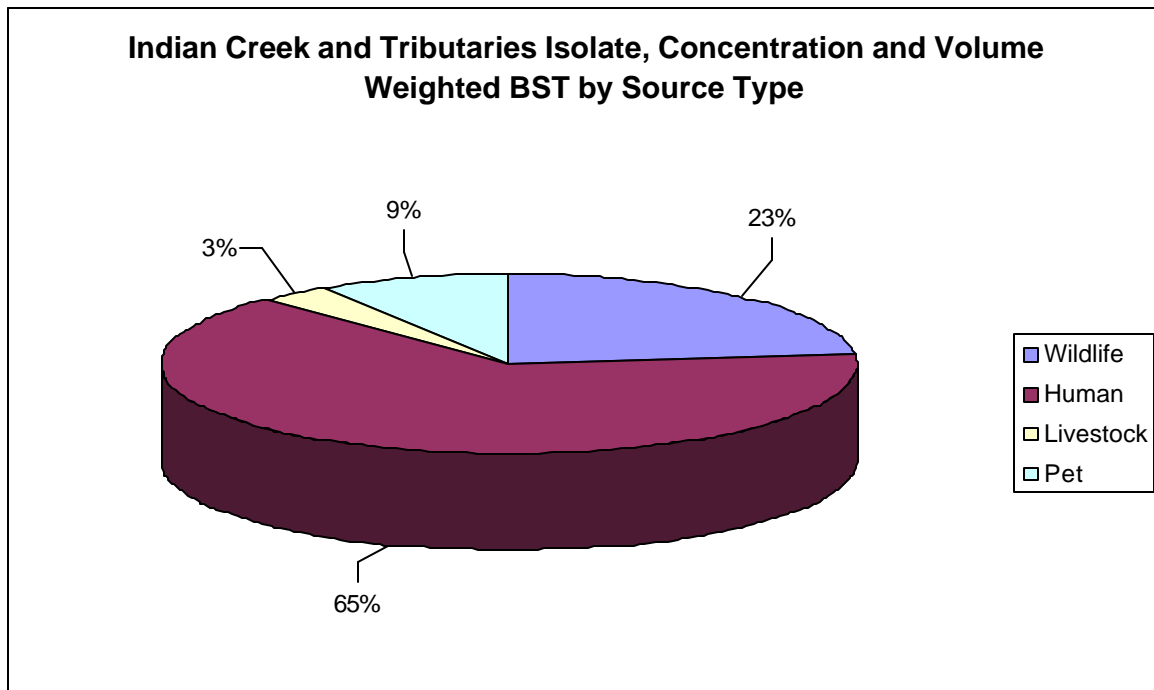
**Table 4.17 Isolate, Concentration, and Volume Weighted Average BST for Tabbs Creek by Type**

<b>Condemnation Area</b>	<b>Livestock</b>	<b>Wildlife</b>	<b>Human</b>	<b>Pet</b>
<b>133 Tabbs Creek</b>	<b>12%</b>	<b>62%</b>	<b>18%</b>	<b>8%</b>

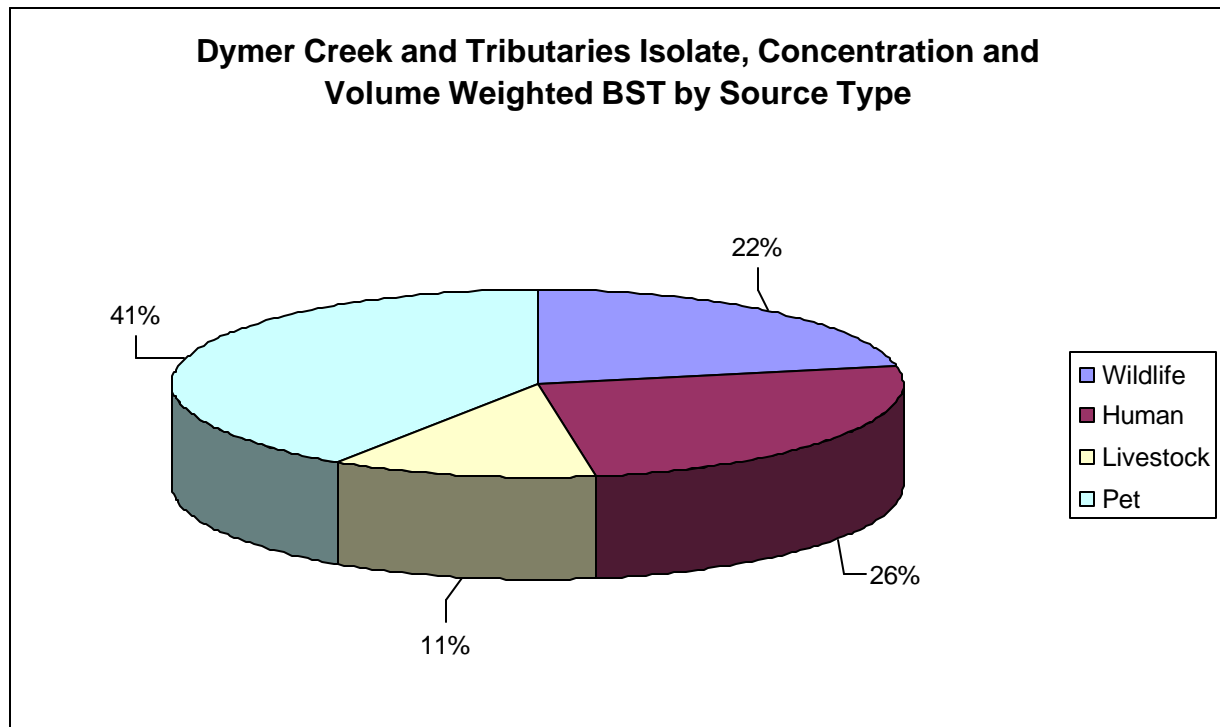
**Table 4.18 Isolate, Concentration, and Volume Weighted Average BST for Antipoison Creek by Type**

<b>Condemnation Area</b>	<b>Livestock</b>	<b>Wildlife</b>	<b>Human</b>	<b>Pet</b>
<b>188 Antipoison Creek</b>	<b>2%</b>	<b>30%</b>	<b>66%</b>	<b>2%</b>

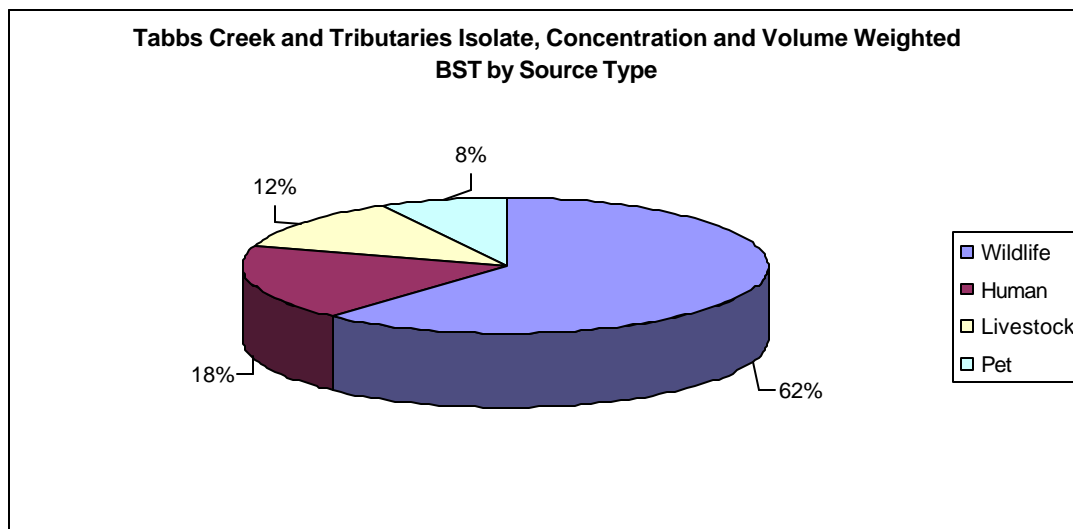
**Figure 4.35 Indian Creek and Tributaries Weighted BST by Source Type**



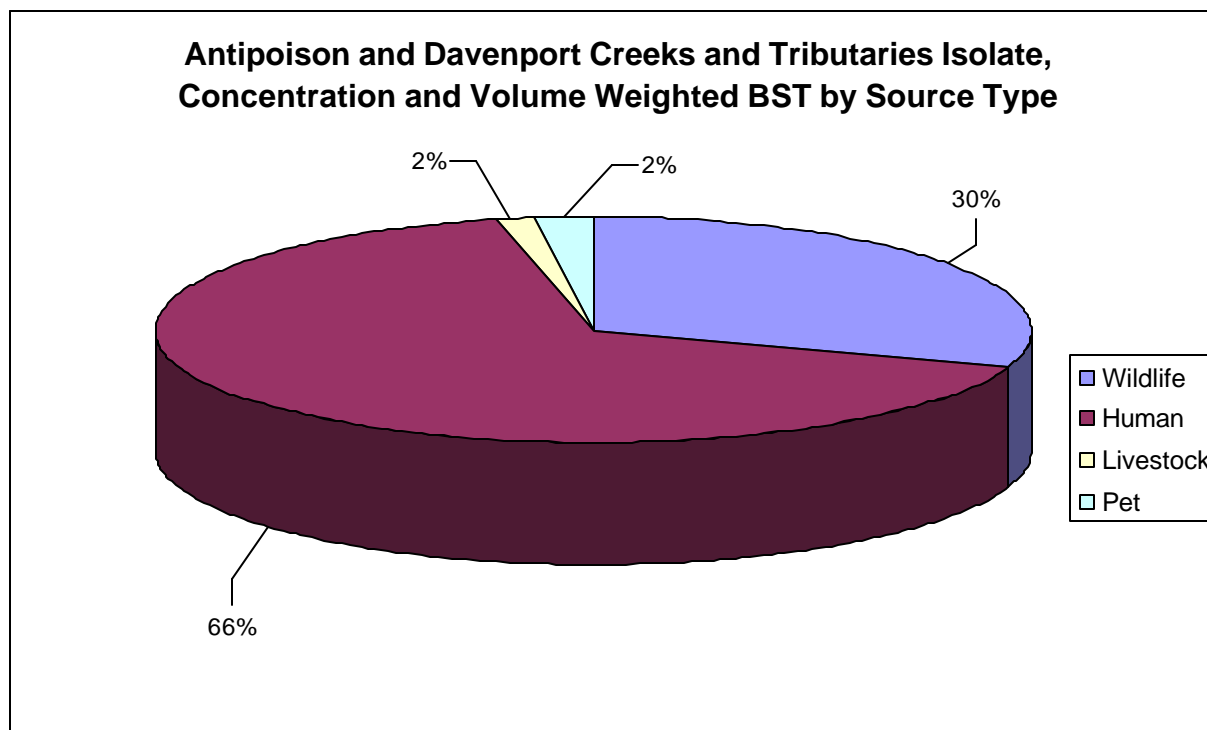
**Figure 4.36 Dymer Creek and Tributaries Weighted BST by Source Type**



**Figure 4.37 Tabbs Creek and Tributaries Weighted BST by Source Type**



**Figure 4.38 Antipoison and Davenport Creeks and Tributaries Weighted BST by Source Type**



## 5.0 TMDL Development

Virginia DEQ and the Virginia Department of Health collaborated to use a simplified volumetric approach to develop the TMDL. The procedure uses bathymetric data to estimate estuarine volumes and BST data and land use to determine the load reductions for each of the four sources of fecal coliform bacteria needed to attain the water quality criteria.

### 5.1 TMDL Calculation

To meet the water quality standards for both geometric mean and 90<sup>th</sup> percentile criteria, TMDLs for the impaired segments in the watershed are defined for the geometric mean load and the 90<sup>th</sup> percentile load. The TMDL for the geometric mean essentially represents the allowable average limit and the TMDL for the 90<sup>th</sup> percentile is the allowable upper limit. If observed data were available for more than one monitoring station in a condemned area, the volume-weighted values for each condemned area were used to represent the embayment concentration.

The “Un-named Cove” in Indian Creek, which is seasonally condemned, will not have a total of 30 monitoring samples until December of 2008. Following DEQ’s obtaining the results for the December 2008 sample, the 90th Percentile and Geomean will be calculated for this station and this information will be available in the final report.

#### A. Current Fecal Coliform Condition

The fecal coliform concentration in an embayment varies due to the changes in biological, hydrological and meteorological conditions. The current condition was determined based on the 30-sample geometric mean and 90<sup>th</sup> percentile of fecal coliform values of each condemned area multiplied by the volume. The monitoring data for the period of record for each station was used to determine the current condition. Data were collected by VDH-DSS from 1984 -2008 for the oldest stations. The maximum values for the period of record for geometric mean and 90<sup>th</sup> percentile multiplied by the volume were used to represent the current loads. Therefore, the current loads represent the worst case scenario observed.

#### B. Geometric Mean Analysis:

The current geometric mean load was estimated using the worst case 30-sample geometric mean multiplied by the estuarine volume determined by bathymetry. The allowable load was calculated using the water quality standard of 14 MPN/100ml multiplied by the volume. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load and dividing by the current load. The process may be described by the equation as follows. The geometric mean results are listed in Tables 5.1 through 5.4.

The geometric mean load reduction is estimated as follows:

$$\text{Geometric Mean Value (max geomean \# MPN/100ml) x (volume) = Existing Load}$$

$$\text{Criteria Value (14 MPN/100ml) x (volume) = Allowable Load}$$

$$\text{Load Reduction} = \frac{\text{Current Load} - \text{Allowable Load}}{\text{Current Load}} \times 100 \%$$

**Table 5.1 Geometric Mean Analysis of Current Load & Estimated Load Reduction in Indian Creek**

Condemnation Area	Volume (m <sup>3</sup> )	Geometric Mean Fecal Coliform (MPN/100ml)	Geometric Mean W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Indian Creek Main Stem	2113725	66.5	14	Implicit	1.40E+12	2.96E+11	79%
Barnes Creek	745896	13.0	14		9.73E+10	1.04E+11	0%
Henry's Creek	434780	13.0	14		5.65E+10	6.09E+10	0%
Bells Creek	254665	12.8	14		3.27E+10	3.57E+10	0%
Long Creek	64641	10.7	14		6.89E+09	9.05E+09	0%

**Table 5.2 Geometric Mean Analysis of Current Load & Estimated Load Reduction in Dyer Creek**

Condemnation Area	Volume (m <sup>3</sup> )	Geometric Mean Fecal Coliform (MPN/100ml)	Geometric Mean W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Dyer Creek Main Stem	1683593	66.3	14	Implicit	1.12E+12	2.36E+11	79%
Ashley Cove	239334	11.1	14		2.65E+10	3.35E+10	0%
Georges Cove	142993	13.9	14		1.98E+10	2.00E+10	0%
Hunts Cove	214452	13.6	14		2.92E+10	3.00E+10	0%
Lees Cove	51140	16.8	14		8.60E+09	7.16E+09	17%



**Table 5.3 Geometric Mean Analysis of Current Load & Estimated Load Reduction in Tabbs Creek**

Condemnation Area	Volume (m <sup>3</sup> )	Geometric Mean Fecal Coliform (MPN/100ml)	Geometric Mean W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Tabbs Creek	1094019	133.7	14	Implicit	1.46E+12	1.53E+11	90%

**Table 5.4 Geometric Mean Analysis of Current Load & Estimated Load Reduction in Antipoison Creek**

Condemnation Area	Volume (m <sup>3</sup> )	Geometric Mean Fecal Coliform (MPN/100ml)	Geometric Mean W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Antipoison Creek	1755494	24.1	14	Implicit	4.23E+11	2.96E+11	42%
Davenport Creek	28118	27.3	14		7.66E+09	3.94E+09	49%

### C. 90th Percentile Analysis

The current 90<sup>th</sup> percentile concentration load was estimated using the worst case 30-sample 90<sup>th</sup> percentile concentration multiplied by the estuarine volume determined by bathymetry. The allowable load was calculated using the water quality standard of 49 MPN/100ml multiplied by the volume. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load and dividing by the current load. The process may be described by the equation as follows. The 90<sup>th</sup> percentile concentration results are listed in Tables 5.5 through 5.8.

The 90<sup>th</sup> percentile load reduction is estimated as follows:

$$90^{\text{th}} \text{ percentile concentration (max } 90^{\text{th}} \text{ \%ile \# MPN/100ml)} \times (\text{volume}) = \text{Existing Load}$$

$$\text{Criteria Value (49 MPN/100ml)} \times (\text{volume}) = \text{Allowable Load}$$

$$\text{Load Reduction} = \frac{\text{Current Load} - \text{Allowable Load}}{\text{Current Load}} \times 100 \%$$

**Table 5.5 90th Percentile Analysis of Current Load and Estimated Load Reduction for Indian Creek**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Indian Creek Main Stem	2113725	854.2	49	Implicit	1.81E+13	1.04E+12	94%
Barnes Creek	745896	79.4	49		5.92E+11	3.65E+11	38%
Henry's Creek	434780	71.8	49		3.12E+11	2.13E+11	32%
Bells Creek	254665	68.5	49		1.75E+11	1.25E+11	28%
Long Creek	64641	93.2	49		6.02E+10	3.17E+10	47%

**Table 5.6 90th Percentile Analysis of Current Load and Estimated Load Reduction for Dymmer Creek**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Dymmer Creek Main Stem	1683593	606.7	49	Implicit	1.02E+13	8.25E+11	92%
Ashley Cove	239334	66.1	49		1.58E+11	1.17E+11	26%
Georges Cove	142993	127.6	49		1.82E+11	7.01E+10	62%
Hunts Cove	214452	81.5	49		1.75E+11	1.05E+11	40%
Lees Cove	51140	103.9	49		5.31E+10	2.51E+10	53%

**Table 5.7 90th Percentile Analysis of Current Load and Estimated Load Reduction for Tabbs Creek**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Tabbs Creek	1094019	1015.5	49	Implicit	1.11E+13	5.36E+11	95%

**Table 5.8 90th Percentile Analysis of Current Load and Estimated Load Reduction for Antipoison Creek**

Condemnation Area	Volume (m <sup>3</sup> )	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Antipoison Creek	1755494	159.8	49	Implicit	2.81E+12	8.60E+11	69%
Davenport Creek	28118	283.9	49		7.98E+10	1.38E+10	83%

**D. Recreational Impairment Analysis**

The instantaneous enterococci water quality standard is used to determine attainment of the recreational (primary contact) designated use. The following language is excerpted from the 2008 Final Water Quality Assessment Guidance Manual:

The enterococci instantaneous standard 104 per 100 ml applies when 2 or more samples per month are not available to calculate a geometric mean. Where data are not sufficient to calculate a geometric mean, at least two exceedences and >10.5% of the total single samples taken during the assessment period exceeding the instantaneous maximum bacteria standard for primary contact recreation is impaired.

VDEQ collects enterococci bacterial samples in Indian Creek at Chesapeake Boat Basin (station ID 7-IND002.26). The recreational use current load for Indian Creek (C01E-29-BAC) is estimated volumetrically by the following equation:

$$\text{Maximum Single Highest Enterococci Value} \times \text{Volume} = \text{Current Load}$$

The recreational use allowable load for Indian Creek (C01E-29-BAC) is estimated volumetrically by the following equation:

$$\text{Enterococci instantaneous standard Value} \times \text{Volume} = \text{Allowable Load (TMDL)}$$

The highest recorded enterococci value for Indian Creek was at monitoring station 7-IND002.26, where enterococci was measured at values greater than 800 cfu/100mL on October 28, 2004, as seen in Table 5.9.

The load reduction for each standard is calculated utilizing a similar approach as used for the shellfish reductions:

$$\frac{\text{Current Load}_{\max} - \text{Allowable Load}}{\text{Current Load}_{\max}} = \text{Load Reduction}$$

The results for these calculations are shown in Table 5.10.

**Table 5.9 Summary of Monitoring Data for Enterococci at Indian Creek (7-IND002.26)**

Station ID	Period of Record	Bacteria Constituent	Total Observations	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Primary Contact Violation Rate
7-IND002.26	7/2003 to 10/2008	<i>Enterococci</i>	49	10	800	12%

**Table 5.10 Summary for the Recreation Use Impairment in Indian Creek**

Impaired Water body Segment	Volume (m <sup>3</sup> )	Bacteria Pollutant	Current Load (cfu/day)	Load Allocation (cfu/day)	Wasteload Allocation (cfu/day)	TMDL (cfu/day)	Margin of Safety	Required Reduction
Indian Creek (C01E-29-BAC)	2128364	<i>Enterococci</i>	1.70E+13	2.21E+12	6.69E+08	2.21E+12	Implicit	87%

## 5.2 Load Allocation

A comparison of the reductions based on geometric mean load and on the 90<sup>th</sup> percentile load shows that the 90<sup>th</sup> percentile load is the critical condition. The 90<sup>th</sup> percentile criterion is most frequently exceeded. Therefore the 90<sup>th</sup> percentile loading is used to allocate source contributions and establish load reduction targets among the various contributing sources that will yield the necessary water quality improvements to attain the water quality standard.

The percent loading for each of source category is based on BST source assessment of the watershed and the land use. These percentages are used to determine where load reductions are needed. The loadings for each source are determined by multiplying the total current and allowable loads by the representative percentage. The percent reduction needed to attain the water quality standard or criterion is allocated to each source category. This is shown in Table 5.11A – 5.11E for Indian Creek, Tables 5.12A – 5.12E for Dymmer Creek, Table 5.13 for Tabbs Creek, and Tables 5.14A & 5.14B for Antipoison Creek. These tables are created to fulfill the TMDL requirements by ensuring that the criterion is attained.

**Table 5.11A Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Indian Creek Main Stem**  
(Indian Creek Main Stem includes Pitmans Cove and Arthur Cove)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Indian Creek Main Stem 016-057	Wildlife	23%	4.16E+12	1.04E+12	75%
	Human	65%	1.18E+13	0.00E+00	100%
	Livestock	3%	5.43E+11	0.00E+00	100%
	Pets	9%	1.63E+12	0.00E+00	100%
	<b>Total</b>	<b>100%</b>	<b>1.81E+13</b>	<b>1.04E+12</b>	<b>94%</b>

**Table 5.11B Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Barnes Creek**  
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Barnes Creek 016-057	Wildlife	23%	1.36E+11	1.36E+11	0%
	Human	65%	3.85E+11	1.58E+11	59%
	Livestock	3%	1.78E+10	1.78E+10	0%
	Pets	9%	5.33E+10	5.33E+10	0%
	<b>Total</b>	<b>100%</b>	<b>5.92E+11</b>	<b>3.65E+11</b>	<b>38%</b>

**Table 5.11C Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Henrys Creek**  
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Henrys Creek 016-057	Wildlife	23%	7.18E+10	7.18E+10	0%
	Human	65%	2.03E+11	1.04E+11	49%
	Livestock	3%	9.36E+09	9.36E+09	0%
	Pets	9%	2.81E+10	2.81E+10	0%
	<b>Total</b>	<b>100%</b>	<b>3.12E+11</b>	<b>2.13E+11</b>	<b>32%</b>

**Table 5.11D Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Bells Creek**  
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Bells Creek 016-057	Wildlife	23%	4.02E+10	4.02E+10	0%
	Human	65%	1.14E+11	6.38E+10	44%
	Livestock	3%	5.25E+09	5.25E+09	0%
	Pets	9%	1.58E+10	1.58E+10	0%
	<b>Total</b>	<b>100%</b>	<b>1.75E+11</b>	<b>1.25E+11</b>	<b>28%</b>

**Table 5.11E Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Long Creek**  
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Long Creek 016-057	Wildlife	23%	1.38E+10	1.38E+10	0%
	Human	65%	3.91E+10	1.07E+10	73%
	Livestock	3%	1.81E+09	1.81E+09	0%
	Pets	9%	5.42E+09	5.42E+09	0%
	<b>Total</b>	<b>100%</b>	<b>6.02E+10</b>	<b>3.17E+10</b>	<b>47%</b>

**Table 5.12A Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Dymer Creek Main Stem**  
(Dymer Creek Main Stem includes Johnson Creek and Chases Cove)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Dymer Creek Main Stem 016-024	Wildlife	22%	2.24E+12	8.25E+11	63%
	Human	26%	2.65E+12	0.00E+00	100%
	Livestock	11%	1.12E+12	0.00E+00	100%
	Pets	41%	4.18E+12	0.00E+00	100%
	<b>Total</b>	<b>100%</b>	<b>1.02E+13</b>	<b>8.25E+11</b>	<b>92%</b>

**Table 5.12B Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Ashley Cove**  
(tributary of Dymer Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Ashley Cove 016-024	Wildlife	22%	3.48E+10	3.48E+10	0%
	Human	26%	4.11E+10	0.00E+00	100%
	Livestock	11%	1.74E+10	1.74E+10	0%
	Pets	41%	6.48E+10	6.48E+10	0%
	<b>Total</b>	<b>100%</b>	<b>1.58E+11</b>	<b>1.17E+11</b>	<b>26%</b>

**Table 5.12C Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Georges Cove**  
(tributary of Dymer Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Georges Cove 016-024	Wildlife	22%	4.00E+10	4.00E+10	0%
	Human	26%	4.73E+10	0.00E+10	100%
	Livestock	11%	2.00E+10	0.00E+00	100%
	Pets	41%	7.46E+10	3.01E+10	60%
	<b>Total</b>	<b>100%</b>	<b>1.82E+11</b>	<b>7.01E+10</b>	<b>66%</b>

**Table 5.12D Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Hunts Cove**  
(tributary of Dymer Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Hunts Cove 016-024	Wildlife	22%	3.85E+10	3.85E+10	0%
	Human	26%	4.55E+10	0.00E+00	100%
	Livestock	11%	1.92E+10	0.00E+00	100%
	Pets	41%	7.18E+10	6.65E+10	7%
	<b>Total</b>	<b>100%</b>	<b>1.75E+11</b>	<b>1.05E+11</b>	<b>40%</b>

**Table 5.12E Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Lees Cove**  
(tributary of Dymer Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Lees Cove 016-024	Wildlife	22%	1.17E+10	1.17E+10	0%
	Human	26%	1.38E+10	0.00E+00	100%
	Livestock	11%	5.84E+09	0.00E+00	100%
	Pets	41%	2.18E+10	1.34E+10	39%
	<b>Total</b>	<b>100%</b>	<b>5.31E+10</b>	<b>2.51E+10</b>	<b>53%</b>

**Table 5.13 Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Tabbs Creek**

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Tabbs Creek 016-0133	Wildlife	62%	6.88E+12	5.36E+11	92%
	Human	18%	2.00E+12	0.00E+00	100%
	Livestock	12%	1.33E+12	0.00E+00	100%
	Pets	8%	8.88E+11	0.00E+00	100%
	<b>Total</b>	<b>100%</b>	<b>1.11E+13</b>	<b>5.36E+11</b>	<b>95%</b>

**Table 5.14A Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Antipoison Creek**

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Antipoison Creek 017-188	Wildlife	30%	8.43E+11	8.43E+11	0%
	Human	66%	1.85E+12	0.00E+00	100%
	Livestock	2%	5.62E+10	8.50E+09	85%
	Pets	2%	5.62E+10	8.50E+09	85%
	<b>Total</b>	<b>100%</b>	<b>2.81E+12</b>	<b>8.60E+11</b>	<b>69%</b>

**Table 5.14B Reductions/Allocations based upon 90<sup>th</sup> Percentile Standard: Davenport Creek**  
(tributary to Fleets Bay north of Antipoison Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Davenport Creek 017-188	Wildlife	30%	2.39E+10	1.38E+10	42%
	Human	66%	5.27E+10	0.00E+00	100%
	Livestock	2%	1.60E+09	0.00E+00	100%
	Pets	2%	1.60E+09	0.00E+00	100%
	<b>Total</b>	<b>100%</b>	<b>7.98E+10</b>	<b>1.38E+10</b>	<b>83%</b>

The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process. Human derived fecal coliforms are a serious concern in the estuarine environment and discharge of human waste is precluded by state and federal law. According to the preceding analysis, small (Bells Creek and Ashley Cove) to large reductions (Indian Creek, Dymer and Tabbs Main Stems) of the controllable loads (e.g. human, livestock, or pets) are necessary to achieve the water quality standard for the condemnation areas. However, due to the episodic listing and delisting patterns related to this condemnation, and to meet the intent of the Clean Water Act, any human loads present should be eliminated from the system. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that no further reductions are necessary or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis (UAA) for the waterbody (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDLs could be implemented to achieve water quality standards; however, the state reserves the right to allocate differently, as long as consistency with the achievement of water quality standards is maintained.

#### A. Development of Wasteload Allocations

There is one permitted discharge for fecal coliform in the watershed, the Kilmarnock Wastewater Treatment Plant. Based on the maximum daily design flow of 0.5 MGD, A WLA of 2.68E+08 is assigned for this facility as noted in Table 5.15 below. The WLA is for the operating outfall which is currently outfall 001. If outfall 002 is ever constructed, the single WLA of 2.68E+08 will be applicable for that outfall as well. Only one outfall is to be in operation at a time.

**Table 5.15 Kilmarnock WWTP Waste Load Allocation (WLA) for Outfalls 001 or 002.**

(The receiving stream is an upper non-tidal tributary to the Indian Creek main stem condemnation.)

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Fecal Coliform Limit (Geomean) (MPN/100ml)	Total Daily Load Outfall 001 or 002 (MPN/day)	Future Growth Factor of 1% (MPN/day)	Total Annual Load Outfall 001 or 002 (MPN/year)	Total Daily WLA for Kilmarnock WWTP (MPN/day)
0.5	1.89E+09	14	2.65E+08	2.65E+06	9.78E+10	2.68E+08



### 5.3 Consideration of Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. The current loading to the waterbody was determined using a long-term record of water quality monitoring (observation) data. The period of record for the data was 1984 to 2008. The resulting estimate is quite robust.

A comparison of the geometric mean values and the 90<sup>th</sup> percentile values against the water quality criteria will determine which represents the more critical condition or higher percent reduction. If the geometric mean values dictate the higher reduction, this suggests that, on average, water sample counts are consistently high with limited variation around the mean. If the 90<sup>th</sup> percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions. For this study, the 90<sup>th</sup> percentile criterion is the most critical condition. Thus, the final load reductions determined using the 90<sup>th</sup> percentile represents the most stringent conditions and it is the reductions based on these bacterial loadings that will yield attainment of the water quality standard. Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. Variations due to changes in the hydrologic cycle as well as temporal variability in fecal coliform sources, such as migrating duck and goose populations are accounted for by the use of the long-term data record to estimate the current load.

### 5.4 Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

### 5.5 TMDL Summary

To meet the water quality standards for both geometric mean and 90<sup>th</sup> percentile criteria, the TMDL for each of the four Creeks must be defined for both the geometric mean load and the 90<sup>th</sup> percentile load, as required by USEPA. A future growth factor of 1% of the total TMDL was included as a Waste Load Allocation to cover future construction of waste treatment facilities. The TMDLs for each creek are summarized in the Tables 5.16A through 5.19B.

**Table 5.16A TMDL Summary for Closures in the Indian Creek Watershed (geometric mean)**

(Indian Creek Main Stem includes Pittmans, Waverly, and Arthur Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN/day (Future Growth)	Load Allocation MPN / Day	Margin of Safety
Indian Creek Main Stem	Fecal Coliform	2.96E+11	2.96E+09	2.93E+11	Implicit
Barnes Creek	Fecal Coliform	1.04E+11	1.04E+09	1.03E+11	
Henry's Creek	Fecal Coliform	6.09E+10	6.09E+08	6.03E+10	
Bells Creek	Fecal Coliform	3.57E+10	3.57E+08	3.53E+10	
Long Creek	Fecal Coliform	6.89E+09	6.89E+07	6.82E+09	

**Table 5.16B TMDL Summary for Closures in the Indian Creek Watershed (90th percentile)**

(Indian Creek Main Stem includes Pittmans, Waverly, and Arthur Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Indian Creek Main Stem	Fecal Coliform	1.04E+12	2.68E+08	1.04E+12	Implicit
Barnes Creek	Fecal Coliform	3.65E+11	3.65E+09	3.61E+11	
Henry's Creek	Fecal Coliform	2.13E+11	2.13E+09	2.11E+11	
Bells Creek	Fecal Coliform	1.25E+11	1.25E+09	1.24E+11	
Long Creek	Fecal Coliform	3.17E+10	3.17E+08	3.14E+10	

**Table 5.17A TMDL Summary Closures in the Dymer Creek Watershed (geometric mean)**  
(Dymer Creek Main Stem includes Johnson Creek and Chases Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Dymer Creek Main Stem	Fecal Coliform	2.36E+11	2.36E+09	2.34E+11	Implicit
Ashley Cove	Fecal Coliform	3.35E+10	3.35E+08	3.32E+10	
Georges Cove	Fecal Coliform	2.00E+10	2.00E+08	1.98E+10	
Hunts Cove	Fecal Coliform	3.00E+10	3.00E+08	2.97E+10	
Lees Cove	Fecal Coliform	7.16E+09	7.16E+07	7.09E+09	

**Table 5.17B TMDL Summary Closures in the Dymer Creek Watershed (90th percentile)**  
(Dymer Creek Main Stem includes Johnson Creek and Chases Cove)

Condemnation Area	Pollutant Identified	TMDL (MPN / day)	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Dymer Creek Main Stem	Fecal Coliform	8.25E+11	8.25E+09	8.17E+11	Implicit
Ashley Cove	Fecal Coliform	1.17E+11	1.17E+09	1.16E+11	
Georges Cove	Fecal Coliform	7.01E+10	7.01E+08	6.94E+10	
Hunts Cove	Fecal Coliform	1.05E+11	1.05E+09	1.04E+11	
Lees Cove	Fecal Coliform	2.51E+10	2.51E+08	2.48E+10	

**Table 5.18A TMDL Summary Closures in the Tabbs Creek Watershed (geometric mean)**

Condemnation Area	Pollutant Identified	TMDL (MPN / day)	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	MOS
Tabbs Creek	Fecal Coliform	1.53E+11	1.53E+09	1.51E+11	Implicit

**Table 5.18B TMDL Summary Closures in the Tabbs Creek Watershed (90th percentile)**

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Tabbs Creek	Fecal Coliform	5.36E+11	5.36E+09	5.31E+11	Implicit

**Table 5.19A TMDL Summary Closures in the Antipoison Creek Watershed (geometric mean)**

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Antipoison Creek	Fecal Coliform	2.96E+11	2.96E+09	2.93E+11	Implicit
Davenport Creek	Fecal Coliform	3.94E+09	3.94E+07	3.90E+09	

**Table 5.19B TMDL Summary Closures in the Antipoison Creek Watershed (90th percentile)**

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Antipoison Creek	Fecal Coliform	8.60E+11	8.60E+09	8.51E+11	Implicit
Davenport Creek	Fecal Coliform	1.38E+10	1.38E+08	1.37E+10	

## 6.0 TMDL Implementation

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. This report represents the culmination of that effort for the bacteria impairments in the Indian, Dymmer, Tabbs, and Antipoison Creeks watersheds. The second step is to develop a TMDL implementation plan. The final step is to implement the TMDL implementation plan and to monitor water quality to determine if water quality standards are being attained.

Following approval of a TMDL report by EPA, measures should be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technology, the

installation of best management practices (BMPs) and designation of No Discharge Zones (NDZ), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The process for developing an implementation plan has been described in the recent “TMDL Implementation Plan Guidance Manual”, published in July 2003 and available upon request from the DEQ and DCR TMDL project staff or at <http://www.deq.state.va.us/tmdl/implans/ipguide.pdf>. With successful completion of implementation plans, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan will improve a locality's chances for obtaining financial and technical assistance during implementation.

## 6.1 Staged Implementation

In general, Virginia intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. For example, in agricultural areas of the watershed, the most promising management practice is livestock or horse exclusion from waterbodies. This has been shown to be very effective in lowering fecal coliform concentrations in waterbodies, both by reducing the fecal deposits themselves and by providing additional riparian buffer to the stream. Other remedial measures which should be considered in these watersheds are pasture management and manure composting facilities.

Protecting existing riparian zones is an inexpensive way to reduce runoff to the impaired water-bodies and will reduce the input of fecal coliform and enterococci bacteria. The Chesapeake Bay Act requires 100 feet of riparian buffer area around Bay watersheds. Education programs for water-front owners in both urban and rural settings along these streams regarding the importance of maintaining riparian buffers would be beneficial.

In both urban and rural areas, reducing the human fecal loading from failing septic systems should be a primary implementation focus because of its health implications. This component could be implemented through education on septic tank pump-outs as well as a septic system repair/replacement program and the use of alternative waste treatment systems. In sewered areas, reducing the loading from leaking sewer lines could be accomplished through a sanitary sewer inspection and management program.

The loadings contributed by domestic pets may be reduced through pet waste education programs, “Scoop the Poop” stations in public areas where dogs are often walked which feature trash receptacles and baggies for cleaning up after pets, pet waste composters for pet owners and veterinary clinics, and septic systems for kennels.

In waterbodies with significant boat traffic, the designation of a No Discharge Zone may effectively reduce bacterial loads to the impaired segments. A No Discharge Zone in the Lynnhaven River in Virginia Beach, VA., resulted in portions of the estuary being re-opened for shellfish harvesting for the first time in over 70 years.

The iterative implementation of BMPs in the watershed has several benefits:

1. It enables tracking of water quality improvements following BMP implementation through follow-up monitoring;

2. It provides a measure of quality control, given the uncertainties inherent in TMDL loading calculations.

3. It provides a mechanism for developing public support through periodic updates on BMP implementation and water quality improvements;

4. It helps ensure that the most cost effective practices are implemented first; and

5. It allows for the evaluation of the adequacy of the TMDL in achieving water quality standards.

Watershed stakeholders will have opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as part of the implementation plan development.

## **6.2 Link to ongoing Restoration Efforts**

Implementation of this TMDL will contribute to on-going water quality improvement efforts aimed at restoring water quality in the Chesapeake Bay. Tributary strategies have been developed for state-wide water quality improvements and for the Chesapeake Bay. Up-to-date information on tributary strategy development can be found at <http://www.snr.state.va.us/Initiatives/WaterQuality/>. There are also local organizations such as the Northern Neck Land Conservancy, Northumberland Association of Progressive Stewardship, in addition to the Northern Neck Soil and Water Conservation District (SWCD – a subsidiary of DCR). These groups will be especially helpful during the IP phase in order to form partnerships to facilitate communication regarding on-going water-quality improvement efforts and reductions in bacteria levels.

## **6.3 Reasonable Assurance for Implementation**

### **A. Follow-Up Monitoring**

VDH-DSS will continue sampling at the established bacteriological monitoring stations in accordance with its shellfish monitoring program. VADEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard.

### **B. Regulatory Framework**

While section 303(d) of the Clean Water Act and current EPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA or the "Act") directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7). The Act also establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits and environmental impacts of addressing the impairments. EPA outlines the minimum elements of an approvable implementation plan in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include implementation actions/management measures, timelines, legal or regulatory controls, time required to attain water quality standards, monitoring plans and milestones for attaining water quality standards.

Once developed, DEQ intends to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP), in accordance with the Clean Water Act's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and DEQ, DEQ also submitted a draft Continuous Planning Process to EPA in which DEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

### C. Implementation Funding Sources

One potential source of funding for TMDL implementation is Section 319 of the Clean Water Act. Other funding sources for implementation include the U.S. Department of Agriculture's Conservation Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, the Virginia Agricultural Best Management Practices Cost Share Program, the Chesapeake Bay Restoration Fund, the Virginia Environmental Endowment, the National Fish and Wildlife Foundation, and the Virginia Water Quality Improvement Fund. The TMDL Implementation Plan Guidance Manual contains additional information on funding sources, as well as government agencies that might support implementation efforts and suggestions for integrating TMDL implementation with other watershed planning efforts.

### D. Addressing Wildlife Contributions

In some waters for which TMDLs have been developed, water quality source identification indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream may not attain standards under all flow regimes at all times. **However, neither the Commonwealth of Virginia nor EPA is proposing the elimination of wildlife to allow for the attainment of water quality standards.** This is obviously an impractical and wholly undesirable action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing of a natural background condition is not the intended goal of a TMDL.

Based on the above, EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop a reduction goal. The pollutant reductions for the interim goal are applied only to controllable, anthropogenic sources identified in the TMDL, setting aside any control strategies for wildlife. During the first implementation phase all controllable sources would be reduced to the maximum extent practicable using the staged approach outlined above. Following completion of the first phase, DEQ would re-assess water quality in the stream to determine if the water quality standard is attained. This effort will also evaluate if the technical assumptions were correct.

If water quality standards are not being met, a special study called a Use Attainability Analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcomes of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s). To remove a designated use, the state must demonstrate 1) that the use is not an existing use, 2) that downstream uses are protected, and 3) that the source of bacterial contamination is natural and uncontrollable by effluent limitations and by implementing cost-effective and reasonable best management practices for non-point source control (9 VAC 25-260-10). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide

Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL comment during this process. Additional information can be obtained at <http://www.deq.state.va.us/wqs/WQS03AUG.pdf>

## **7.0 Public Participation**

During development of the TMDL for the Indian, Dyer, Tabbs, and Antipoison Creeks watersheds, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first technical advisory committee and public meetings were held on September 29, 2008. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings

was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. There were 9 public comments received. The TMDL load allocations were presented during the second public meeting held on November 14, 2008. There were 7 public comments received. The public meetings were advertised in the local media, signs advertising the meeting were placed at high access road intersections in the watershed for two weeks before the meeting, and email invitations were sent to local government and stakeholders.



## 8.0 Glossary

**303(d).** A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

**Allocations.** That portion of receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. (A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

**Ambient water quality.** Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

**Anthropogenic.** Pertains to the [environmental] influence of human activities.

**Bacteria.** Single-celled microorganisms. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

**Bacterial source tracking (BST).** A collection of scientific methods used to track sources of fecal contamination.

**Best management practices (BMPs).** Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

**Biosolids.** Also known as Sewage sludge, is the name for the solid, semisolid, or liquid materials removed during the treatment of domestic sewage in a treatment facility. Biosolids include, but are not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings, and sewage sludge products. When properly treated and processed, sewage sludge becomes "biosolids" which can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

**Clean Water Act (CWA).** The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

**Concentration.** Amount of a substance or material in a given unit volume of solution; usually measured in milligrams per liter (mg/L) or parts per million (ppm).

**Contamination.** The act of polluting or making impure; any indication of chemical, sediment, or biological impurities.

**Cost-share program.** A program that allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The remainder of the costs is paid by the producer(s).

**Critical condition.** The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

**Designated uses.** Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

**Domestic wastewater.** Also called sanitary wastewater, consists of wastewater discharged from residences and from commercial, institutional, and similar facilities.

**Drainage basin.** A part of a land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. Also referred to as a watershed, river basin, or hydrologic unit.

**Existing use.** Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).

**Fecal Coliform.** Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract.

**Geometric mean.** A measure of the central tendency of a data set that minimizes the effects of extreme values.

**GIS.** Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989)

**Infiltration capacity.** The capacity of a soil to allow water to infiltrate into or through it during a storm.

**Interflow.** Runoff that travels just below the surface of the soil.

**Loading, Load, Loading rate.** The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in weight per unit time.

**Load allocation (LA).** The portion of a receiving waters loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)).

**Loading capacity (LC).** The greatest amount of loading a water body can receive without violating water quality standards.

**Margin of safety (MOS).** A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body (CWA section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by EPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a  $TMDL = LC = WLA + LA + MOS$ ).

**Mean.** The sum of the values in a data set divided by the number of values in the data set.

**Monitoring.** Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

**Narrative criteria.** Non-quantitative guidelines that describe the desired water quality goals.

**Nonpoint source.** Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.

**Numeric targets.** A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.

**Point source.** Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water waterbody or river.

**Pollutant.** Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).

**Pollution.** Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

**Privately owned treatment works.** Any device or system that is (a) used to treat wastes from any facility whose operator is not the operator of the treatment works and (b) not a publicly owned treatment works.

**Public comment period.** The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

**Publicly owned treatment works (POTW).** Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

**Raw sewage.** Untreated municipal sewage.

**Receiving waters.** Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

**Riparian areas.** Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.

**Riparian zone.** The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.

**Runoff.** That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

**Septic system.** An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

**Sewer.** A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers handle both.

**Slope.** The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04), degrees (2 degrees 18 minutes), or percent (4 percent).

**Stakeholder.** Any person with a vested interest in the TMDL development.

**Surface area.** The area of the surface of a waterbody; best measured by planimetry or the use of a geographic information system.

**Surface runoff.** Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.

**Surface water.** All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.

**Topography.** The physical features of a geographic surface area including relative elevations and the positions of natural and man-made features.

**Total Maximum Daily Load (TMDL).** The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural

Background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

**VADEQ.** Virginia Department of Environmental Quality.

**VDH.** Virginia Department of Health.

**Virginia Pollutant Discharge Elimination System (NPDES).** The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.

**Wasteload allocation (WLA).** The portion of a receiving waters' loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).

**Wastewater.** Usually refers to effluent from a sewage treatment plant. See also **Domestic wastewater.**

**Wastewater treatment.** Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.

**Water quality.** The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.

**Water quality criteria.** Levels of water quality expected to render a body of water suitable for its designated use, composed of numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

**Water quality standard.** Law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

**Watershed.** A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

**WQIA.** Water Quality Improvement Act.

## 9.0 Citations

Bacterial Source Tracking Analyses to Support Virginia's TMDLs: Shellfish Stations. December 2004. Map Tech Inc. in cooperation with New River Highlands RC & D. Blacksburg, Virginia

US EPA Shellfish Workshop Document (2002).

VA DEQ 1998 303(d) List of Impaired Waters.

## **10.0 Appendices**

**Appendix A Growing Area 016: Shoreline Sanitary Survey and Condemnation Notices  
Growing Area 017: Shoreline Sanitary Survey and Condemnation Notices**

**Appendix B Supporting Documentation and Watershed Assessment**

**Appendix C Water Quality Data**

**Appendix D 1) Code of Virginia §62.1-194.1 Obstructing or contaminating state  
waters.  
2) 33 CFR Volume 2, Parts 120 to 199. Revised as of July 1, 2000**

## Appendix A:

16  
GROW AREA



### COMMONWEALTH of VIRGINIA

RANDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER

Department of Health  
P O BOX 2448  
RICHMOND, VA. 23218

TDD 1-800-828-1120

#### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 57, INDIAN CREEK

EFFECTIVE 5 MARCH 1997

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 13 March 1996, is cancelled effective 5 March 1997.
2. Condemned Shellfish Area Number 57, Indian Creek, is established, effective 5 March 1997, and shall consist of areas A, B, and C described below. As to areas A and C, it shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to area B, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of the area are shown on map titled "Indian Creek, Condemned Shellfish Area No. 57, 5 March 1997" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 57

- A. The condemned area shall include all of that portion of Pitmans Cove and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "A-M" due south to the opposite shore.
- B. The condemned area shall include all of that portion of the Indian Creek tributary leading to the Town of Kilmarnock lying upstream of a line drawn due south from the fourth point of land on the north shore upstream from the westernmost point of Warehouse Point.



Shellfish Area Condemnation  
Number 57  
Page Two

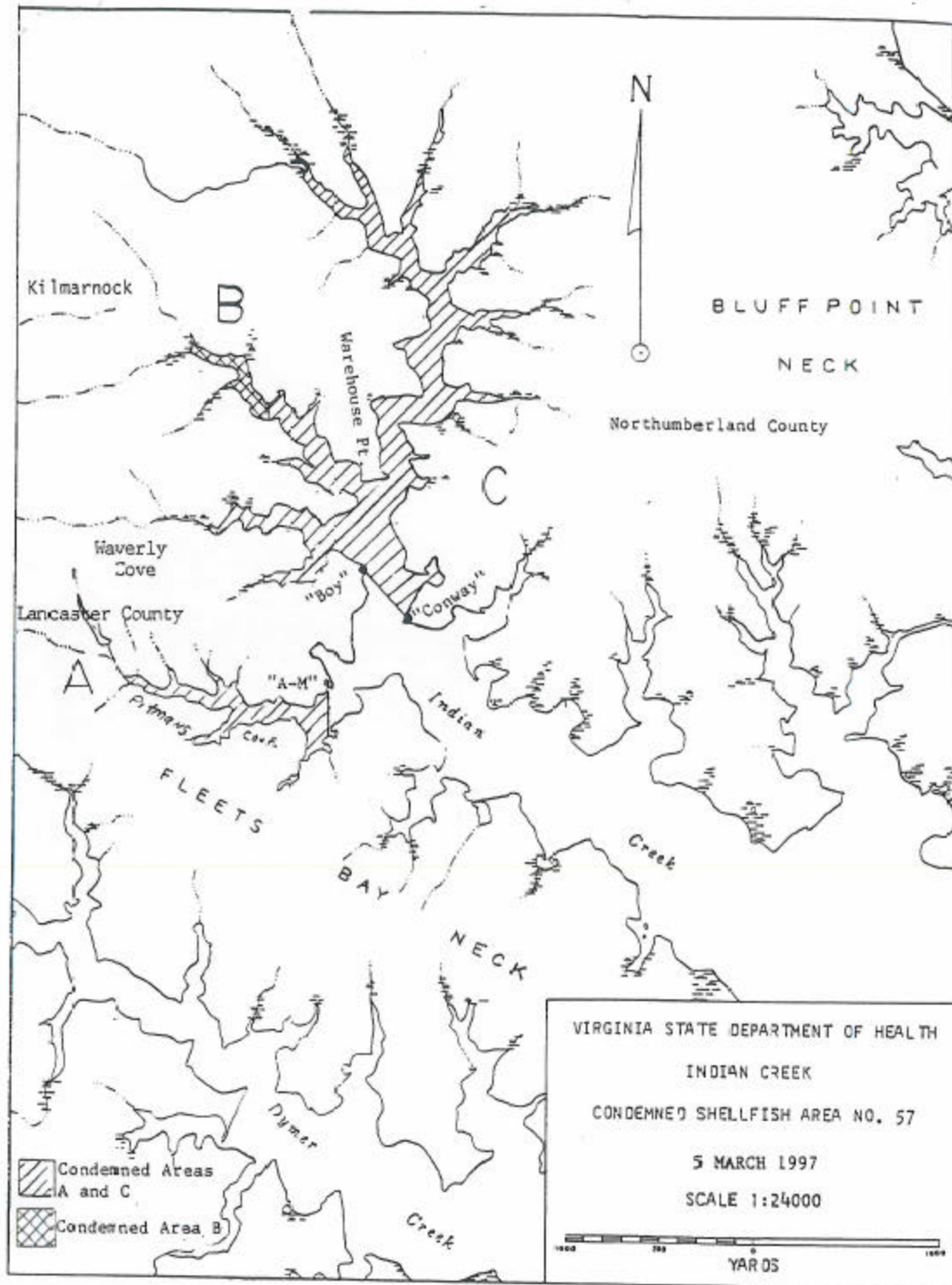
- C. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of the line drawn between Marine Resources Commission survey markers "Boy" and "Conway;" but shall exclude the area described in Part B.

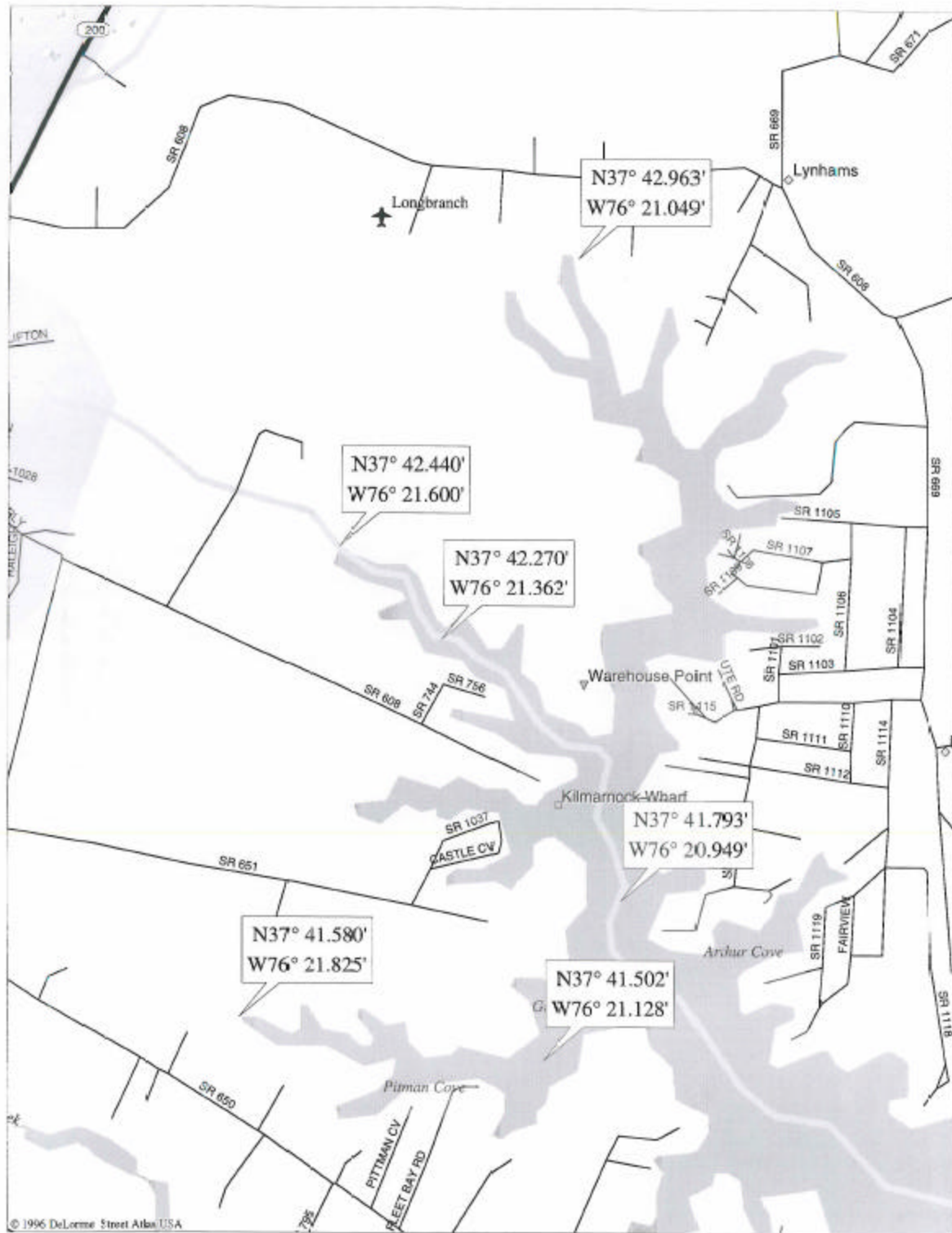
Recommended by: *[Signature]*  
*[Signature]* Director, Division of Shellfish Sanitation

Ordered by: *Randy Anderson by [Signature]* *2-20-87*  
State Health Commissioner *Deputy* Date



Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL







# COMMONWEALTH of VIRGINIA

RANDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER

*Department of Health  
Office of Water Programs  
Division of Shellfish Sanitation  
1500 East Main Street, Suite 109  
Richmond, Virginia 23219-3635*

PHONE (804) 786-7937  
FAX (804) 786-5567

## NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 57, INDIAN CREEK

**EFFECTIVE 27 February 1998**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 5 March 1997, is cancelled effective 27 February 1998.
2. Condemned Shellfish Area Number 57, Indian Creek, is established, effective 27 February 1998, and shall consist of areas A, B, and C described below. As to areas A and C, it shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to area B, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of the area are shown on map titled "Indian Creek, Condemned Shellfish Area No. 57, 27 February 1998" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 57

- A. The condemned area shall include all of that portion of Pitmans Cove and its tributaries lying upstream of a line between Marine Resources Commission survey markers "D-M" and "C-M."
- B. The condemned area shall include all of that portion of the Indian Creek tributary leading to the Town of Kilmarnock lying upstream of a line drawn due south from the fourth point of land on the north shore upstream from the westernmost point of Warehouse Point.

**VDH** VIRGINIA  
DEPARTMENT  
OF HEALTH  
*Protecting You and Your Environment*

Shellfish Area Condemnation  
Number 57  
Page Two

- C. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of the line drawn between Marine Resources Commission survey markers "Boy" and "Conway;" but shall exclude the area described in Part B.

Recommended by:

*W. C. Crocker*  
Director, Division of Shellfish Sanitation

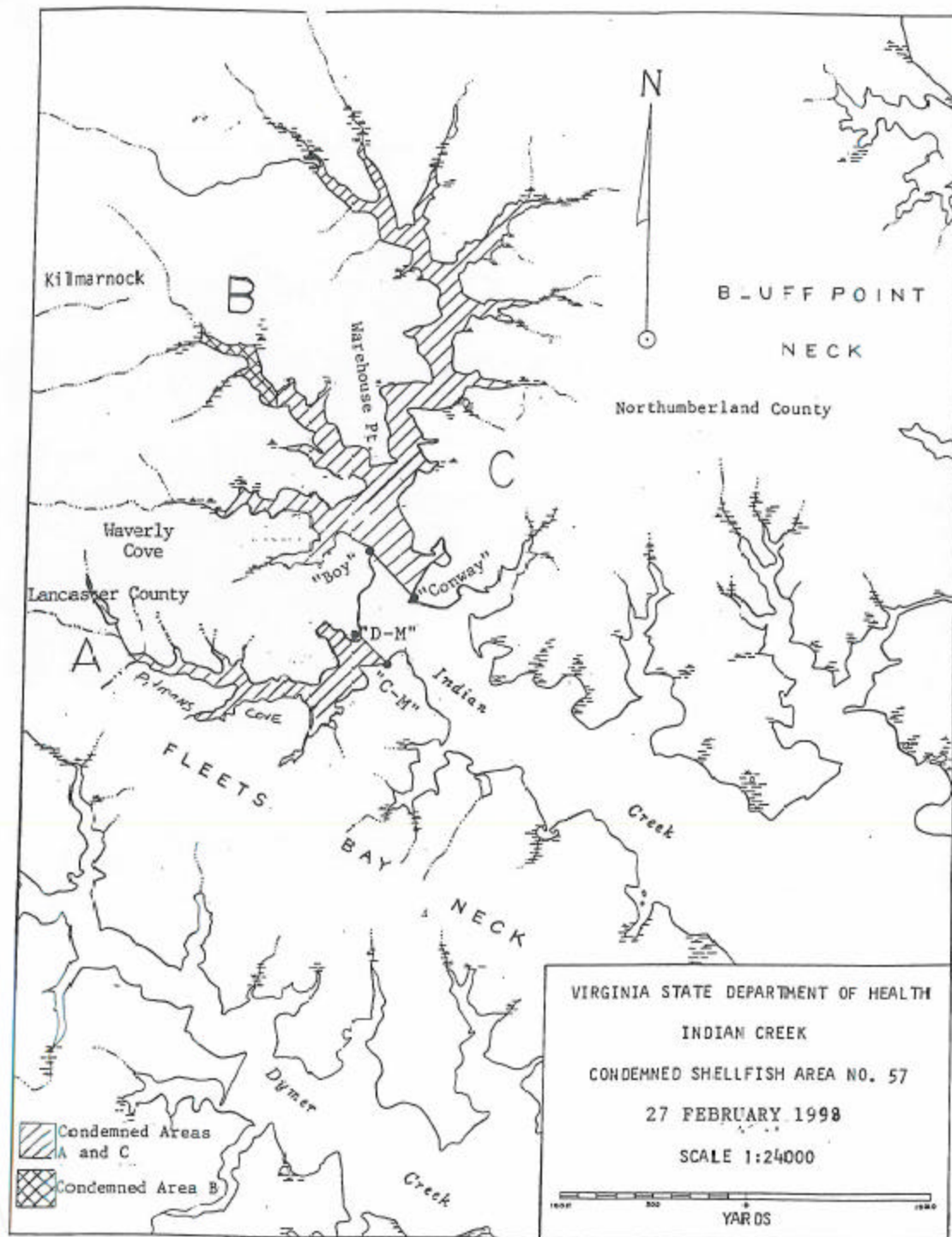
Ordered by:

*Carl W. Donohue* *2/17/98*  
State Health Commissioner Date

SIGNED PURSUANT TO  
AUTHORITY VESTED IN  
DEPUTY HEALTH COMMISSIONER  
BY §2.1-20-01:2; CODE OF VA



Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL





## COMMONWEALTH of VIRGINIA

Department of Health

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 57, INDIAN CREEK

**EFFECTIVE 21 JUNE 1999**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 19 February 1999, is cancelled effective 21 June 1999.
2. Condemned Shellfish Area Number 57, Indian Creek, is established, effective 21 June 1999, and shall consist of areas A, B, C and D described below. As to areas A, C and D, it shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to area B, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of the area are shown on map titled "Indian Creek, Condemned Shellfish Area No. 57, 21 June 1999" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### **BOUNDARIES OF CONDEMNED AREA NUMBER 57**

- A. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Kil" due east to the opposite shore and downstream of the line described in Part B.
- B. The condemned area shall include all of that portion of the Indian Creek tributary leading to the Town of Kilmarnock lying upstream of a line drawn due south from the fourth point of land on the north shore upstream from the westernmost point of Warehouse Point.
- C. The condemned area shall include all of that portion of Waverly Cove and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Kil" and "Boy."

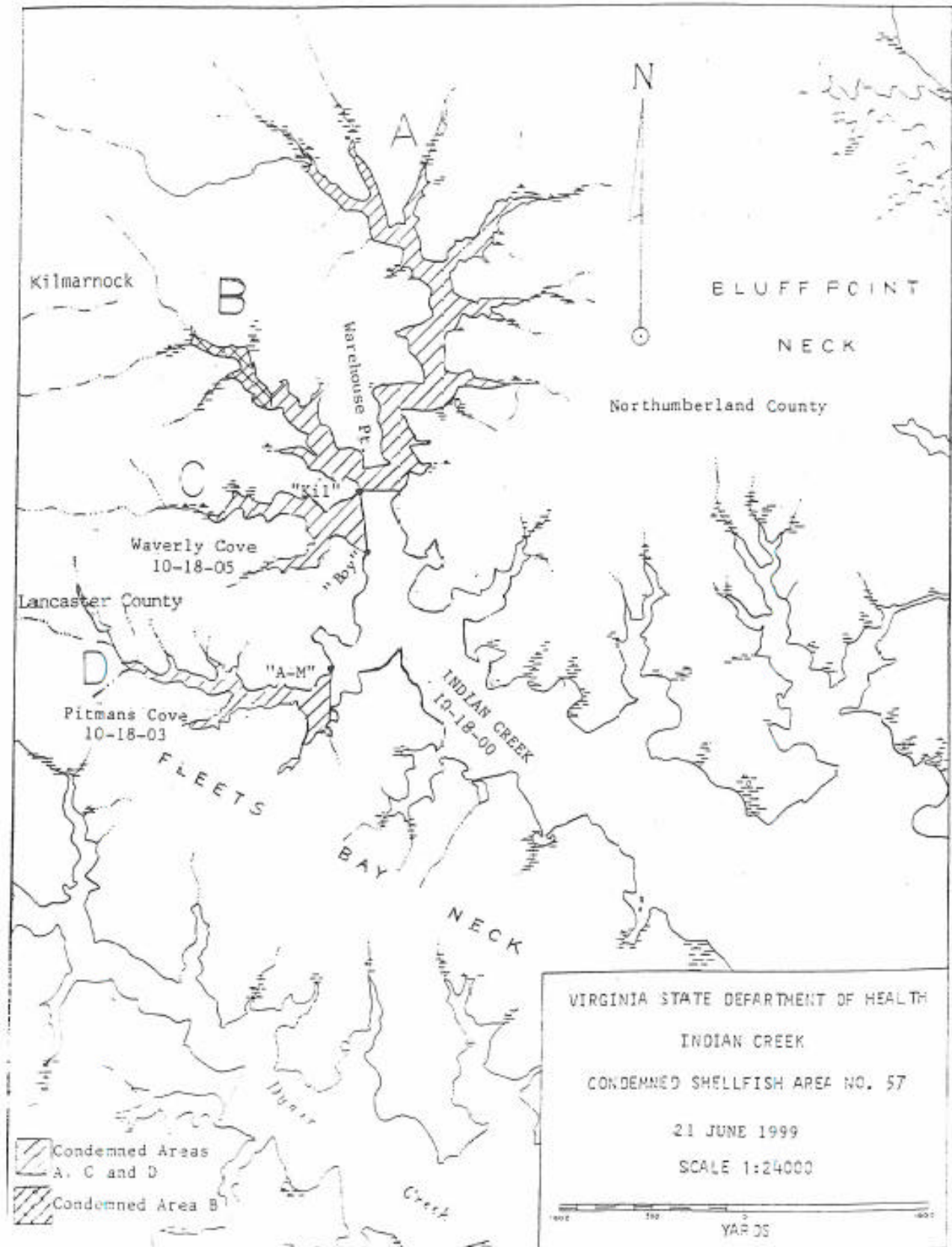
Shellfish Area Condemnation  
Number 57  
Page Two

- D. The condemned area shall include all of that portion of Pitmans Cove and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "A-M" due south to the opposite shore.

Recommended by: *R.H.E. Lomenberghs*  
Director, Division of Shellfish Sanitation

Ordered by: *E. James Fitzsimons MD MPH* *6/16/88*  
Acting State Health Commissioner Date







## COMMONWEALTH of VIRGINIA

Department of Health

E. ANNE PETERSON, M.C., M.P.H.  
STATE HEALTH COMMISSIONER

P.O. BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 57, INDIAN CREEK

EFFECTIVE 14 JULY 2000

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 21 June 1999, is cancelled effective 14 July 2000.
2. Condemned Shellfish Area Number 57, Indian Creek, is established, effective 14 July 2000, and shall consist of areas A, B and C described below. As to areas A and B, it shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to area C, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of the area are shown on map titled "Indian Creek, Condemned Shellfish Area Number 57, 14 July 2000" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 57

- A. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "TRAV." through the westernmost point of plat #10724 to the opposite shore and downstream of the line described in Part C.
- B. The condemned area shall include all of that portion of Pitmans Cove and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Turner" westerly to the prominent point of land on the opposite shore.
- C. The condemned area shall include all of that portion of the Indian Creek tributary leading to the Town of Kilmarnock lying upstream of a line drawn due south from the fourth point of land on the north shore upstream from the westernmost point of Warehouse Point.

Recommended by:

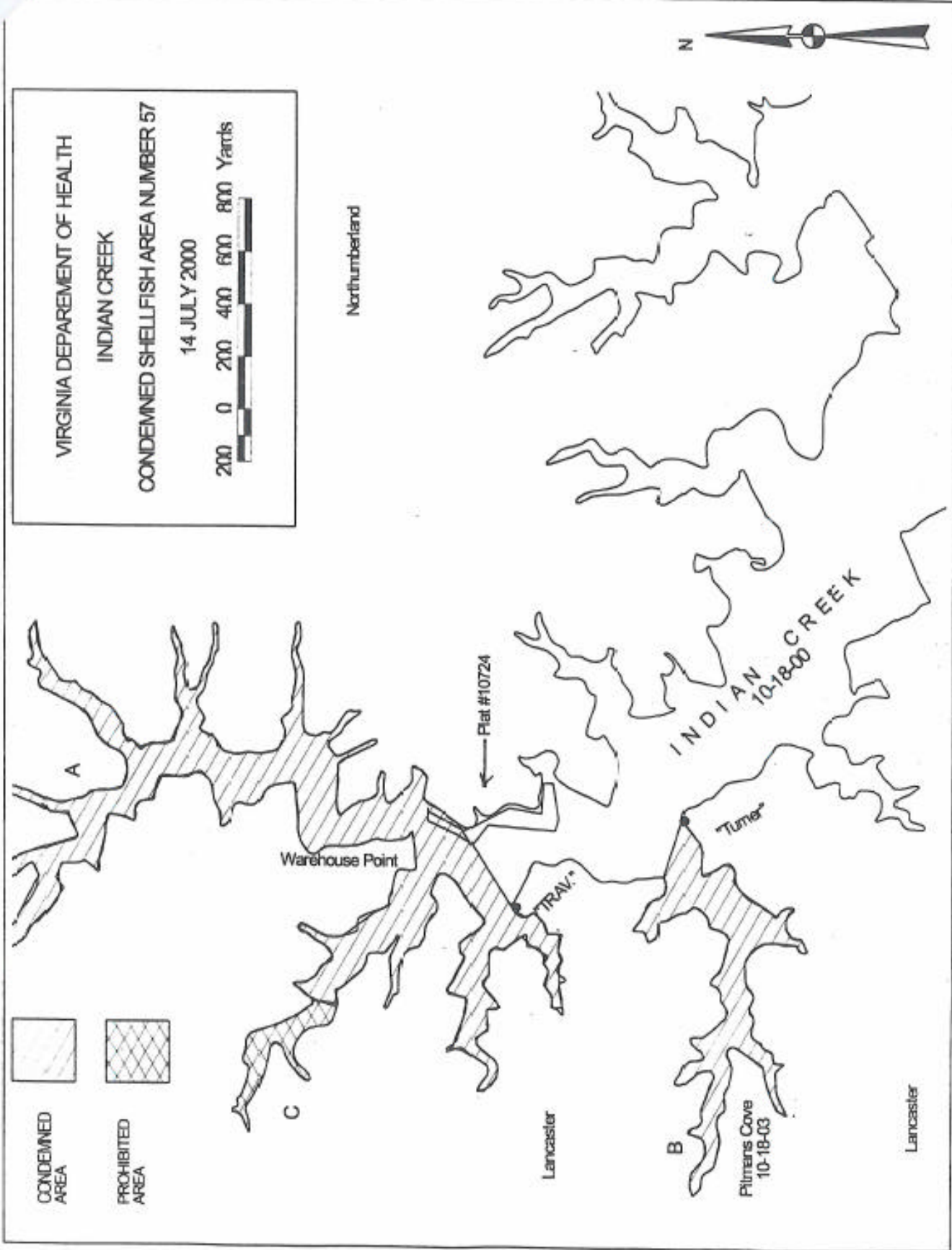
Director, Division of Shellfish Sanitation

Ordered by:

State Health Commissioner

Date

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OF HEALTH  
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## COMMONWEALTH of VIRGINIA

Department of Health

E. ANNE PETERSON, M.D., M.P.H.  
STATE HEALTH COMMISSIONER

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 57, INDIAN CREEK

EFFECTIVE 30 NOVEMBER 2000


Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 14 July 2000, is cancelled effective 30 November 2000.
2. Condemned Shellfish Area Number 57, Indian Creek, is established, effective 30 November 2000, and shall consist of areas A and B described below. As to area A it shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to area B, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of the area are shown on map titled "Indian Creek, Condemned Shellfish Area Number 57, 20 November 2000" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 57

- A. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Turner" easterly to the prominent point of land on the opposite shore and downstream of the line described in Part B.
- B. The condemned area shall include all of that portion of the Indian Creek tributary leading to the Town of Kilmarnock lying upstream of a line drawn due south from the fourth point of land on the north shore upstream from the westernmost point of Warehouse Point.

Recommended by:

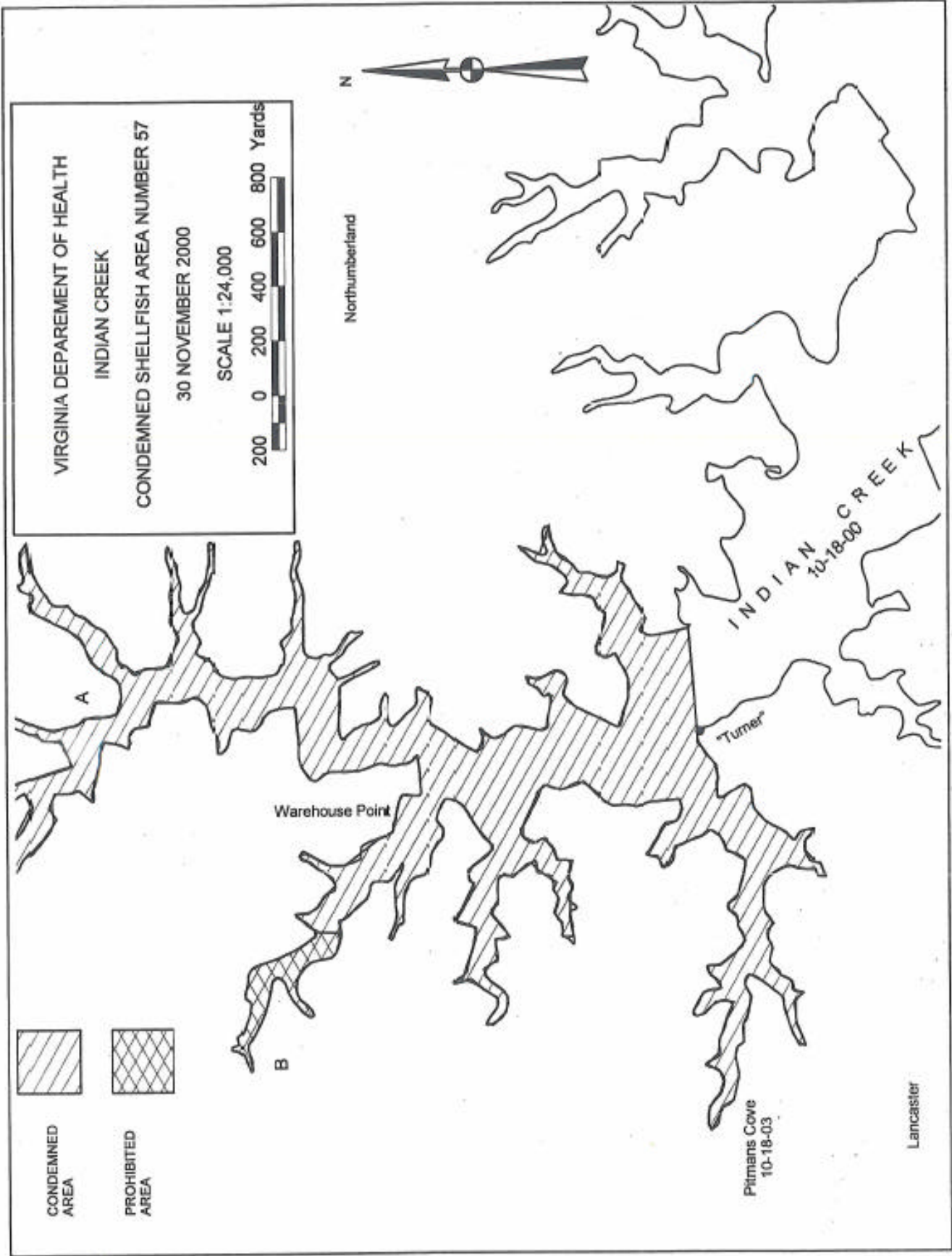
  
J. L. Smith, Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

11/29/2000

Date.





REGISTER OF REGULATIONS

05 JAN 11 PM 4:26

## COMMONWEALTH of VIRGINIA

Department of Health  
DIVISION OF SHELLFISH SANITATION  
109 Commerce Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 016-057, INDIAN CREEK

EFFECTIVE 28 JANUARY 2005

Pursuant to Title 23.2, Chapter 8, §§28.2-833 through 28.2-808, §32.1-2C, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 57, Indian Creek," effective 30 November 2000, is cancelled effective 28 January 2005.
2. The "Notice of Establishment and Description of Seasonally Condemned Shellfish Area at Marina Facility Designation M-174, Northumberland County," effective 13 April 1989 is cancelled effective 28 January 2005.
3. Condemned Shellfish Area Number 016-057, shown as Sections A, B, C, D, and E, is established, effective 28 January 2005. As to Sections A, B, C, and D, it shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to Section E, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of these sections are shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 28 January 2005" which is part of this notice.
4. The seasonal shellfish condemnation area Number 016-057 shown as Section M1 is hereby established, effective 1 April 2005, and shall remain in force annually thereafter for the period beginning the first day of April through the last day of October until rescinded. It is unlawful for any person, firm or corporation to take shellfish from these areas during such period for any purpose, except by permit granted by Marine Resources Commission, as provided in §28.2-810 of the *Code of Virginia*. The boundary of this section is shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 28 January 2005" which is part of this notice.
5. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.



**BOUNDARIES OF CONDEMNED AREA NUMBER 016-057**

- A. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'34.6", -76°20'53.4") and map coordinate (37°41'34.7", -76°20'38.5"), but excluding the area defined as Section E.
- B. The condemned area shall include all of that portion of Bells Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'25.0", -76°20'10.3") and map coordinate (37°41'21.2", -76°20'04.7").
- C. The condemned area shall include all of that portion of Henrys Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'21.1", -76°19'32.7") and map coordinate (37°41'25.4", -76°19'24.9"), as well as all of that portion of Barnes Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'10.8", -76°18'47.8") and map coordinate (37°41'19.4", -76°18'26.2").
- D. The condemned area shall include all of that portion of Long Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'20.5", -76°20'46.0") and map coordinate (37°41'18.8", -76°20'45.0").
- E. The condemned area shall include all of that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°42'16.9", -76°21'20.5") and map coordinate (37°42'14.2", -76°21'21.3").
- M1. The condemned area shall include all of that portion of Indian Creek lying inland of a line drawn between latitude/longitude map coordinate (37°41'30.0", -76°20'36.2") and map coordinate (37°41'24.7", -76°20'19.8").

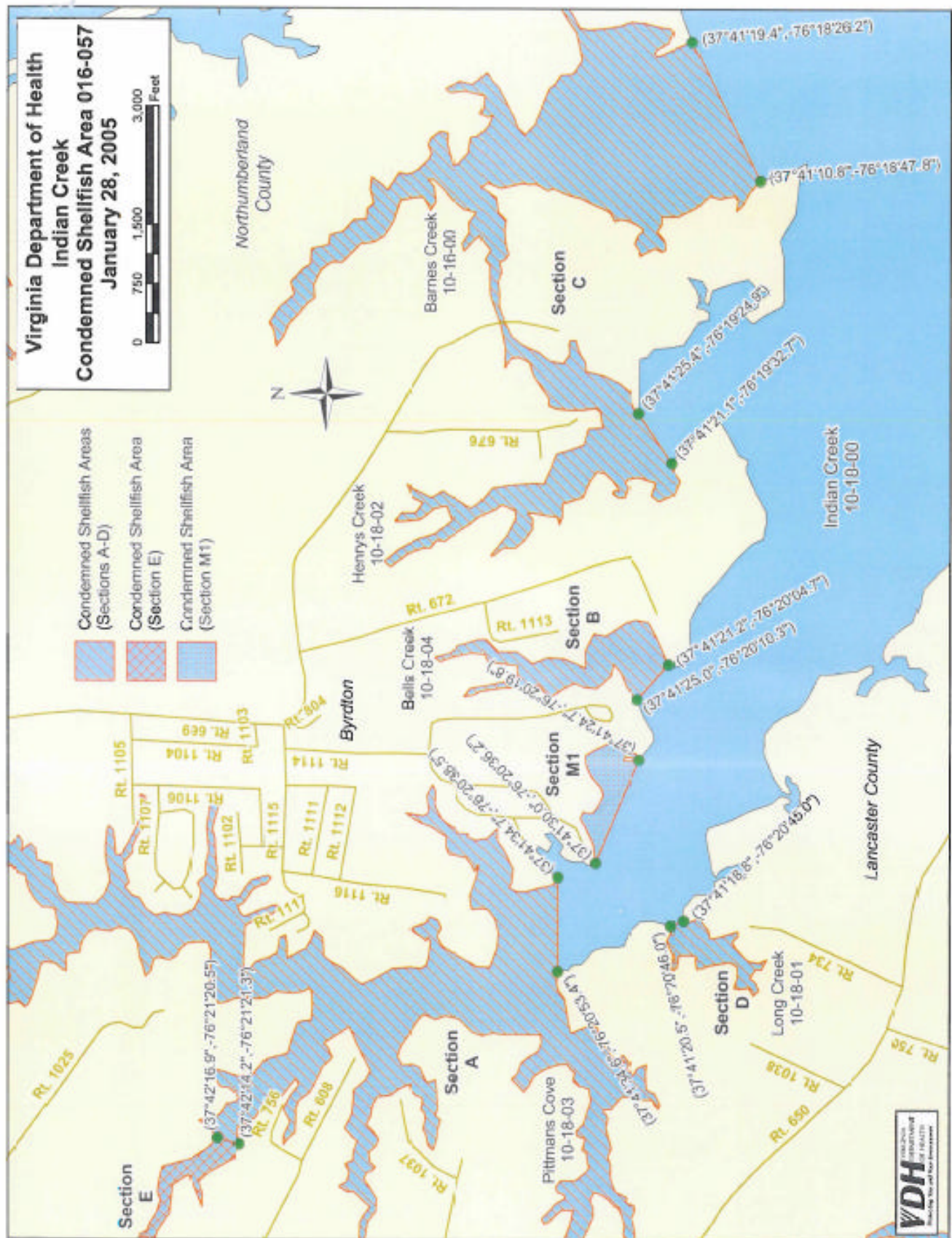
Recommended by:

  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

01/11/2005  
Date







**COMMONWEALTH of VIRGINIA**

**Department of Health  
DIVISION OF SHELLFISH SANITATION**  
109 Governor Street, Room 614-B  
Richmond, VA 23219

REGISTRAR OF REGULATIONS

06 DEC -4 AM 10:23

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-057, INDIAN CREEK**

**EFFECTIVE 13 DECEMBER 2006**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 016-057, Indian Creek," effective 28 January 2005, is cancelled effective 13 December 2006.
2. Condemned Shellfish Area Number 016-057, shown as Sections A, B, C, D, E, and F, is established, effective 13 December 2006. As to Sections A, B, C, D, and E, it shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to Section F, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of these areas are shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 13 December 2006" which is part of this notice.
3. The seasonal shellfish condemnation area Number 016-057 shown as Section M1 is hereby established, effective 1 April 2007, and shall remain in force annually thereafter for the period beginning the first day of April through the last day of October until rescinded. It is unlawful for any person, firm or corporation to take shellfish from these areas during such period for any purpose, except by permit granted by Marine Resources Commission, as provided in §28.2-810 of the *Code of Virginia*. The boundary of this area is shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 13 December 2006" which is part of this notice.
4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-057**

- A. The condemned area shall include that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'34.6", -76°20'53.4") and map coordinate (37°41'35.1", -76°20'39.4"); but excluding the area defined as Section F.
- B. The condemned area shall include that portion of Bells Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'25.0", -76°20'10.3") and map coordinate (37°41'21.2", -76°20'04.7").

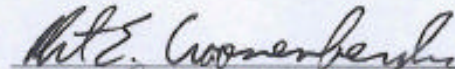
**VDH** VIRGINIA  
DEPARTMENT  
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[www.vdh.virginia.gov/shellfish](http://www.vdh.virginia.gov/shellfish)



Shellfish Condemnation # 316-057  
Page 2

- C. The condemned area shall include all of Barnes Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°41'29.4", -76°19'27.3") and map coordinate (37°41'25.4", -76°19'25.7"), as well as upstream of a line drawn between latitude / longitude map coordinate (37°41'10.7", -76°18'47.8") and map coordinate (37°41'19.4", -76°18'26.2").
- D. The condemned area shall include all of Long Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'20.5", -76°20'45.9") and map coordinate (37°41'18.8", -76°20'45.0").
- E. The condemned area shall include that portion of Henrys Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°41'30.7", -76°19'35.2") and map coordinate (37°41'29.4", -76°19'27.3").
- F. The condemned area shall include that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°42'17.0", -76°21'20.4") and map coordinate (37°42'14.2", -76°21'21.3").
- M1. The seasonally condemned area shall include that portion of Indian Creek lying inland of a line drawn between latitude/longitude map coordinate (37°41'30.0", -76°20'36.1") and map coordinate (37°41'24.9", -76°20'20.0").

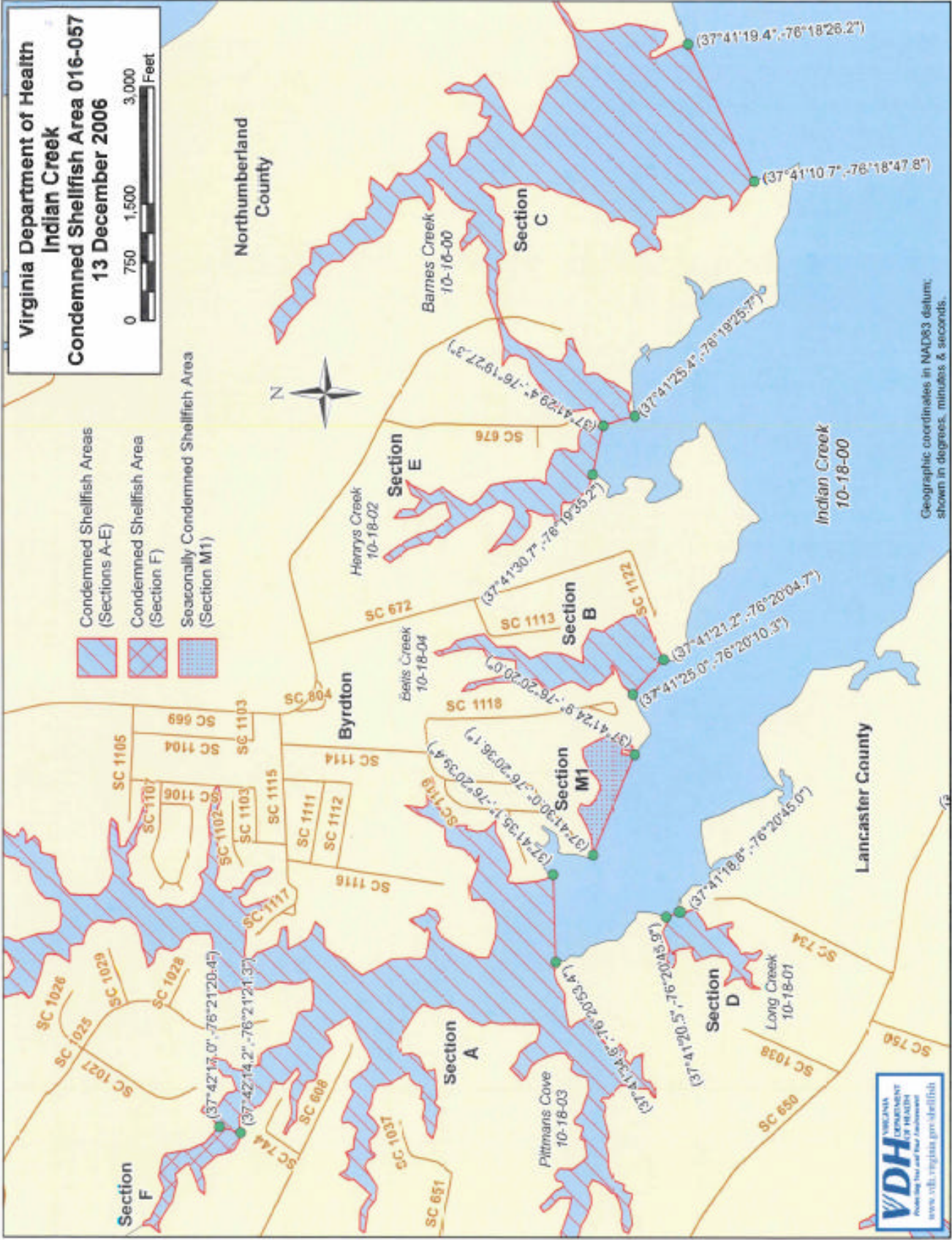
Recommended by:

  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

12/1/06  
Date







**COMMONWEALTH of VIRGINIA**

**Department of Health  
DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

REGISTRAR OF REGULATIONS  
07 DEC 14 PM 2: 23

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-057, INDIAN CREEK**

**EFFECTIVE 28 DECEMBER 2007**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 016-057, Indian Creek," effective 13 December 2006, is cancelled effective 28 December 2007.
2. Condemned Shellfish Area Number 016-057, shown as Sections A, B and C, is established, effective 28 December 2007. As to Sections A and B, it shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. As to Section C, it shall be unlawful for any person, firm or corporation to take shellfish from this area, for any purpose. The boundaries of these areas are shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 28 December 2007" which is part of this notice.
3. Seasonally Condemned Shellfish Area Number 016-057, shown as Section M1 is established, effective 1 April 2008, and shall remain in force annually thereafter for the period beginning the first day of April through the last day of October until rescinded. It is unlawful for any person, firm or corporation to take shellfish from this area during such period for any purpose, except by permit granted by Marine Resources Commission, as provided in §28.2-810 of the *Code of Virginia*. The boundaries of this area are shown on the map titled "Indian Creek, Condemned Shellfish Area Number 016-057, 28 December 2007" which is part of this notice.
4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-057**

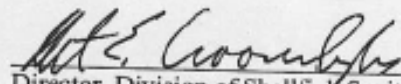
- A. The condemned area shall include that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°41'55.9", -76°20'53.7") and map coordinate (37°41'51.4", -76°21'01.2"); but excluding the area defined as Section C.

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Shellfish Condemnation # 016-057  
Page 2

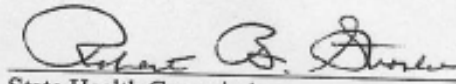
- B. The condemned area shall include that portion of Pittmans Cove and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°41'33.2", -76°21'07.8") and map coordinate (37°41'32.4", -76°21'03.8").
- C. The condemned area shall include that portion of Indian Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°42'17.0", -76°21'20.4") and map coordinate (37°42'14.2", -76°21'21.3").
- M1. The seasonally condemned area shall include that portion of Indian Creek lying inland of a line drawn between latitude / longitude map coordinate (37°41'30.0", -76°20'36.1") and map coordinate (37°41'24.9", -76°20'20.0").

Recommended by:



Director, Division of Shellfish Sanitation

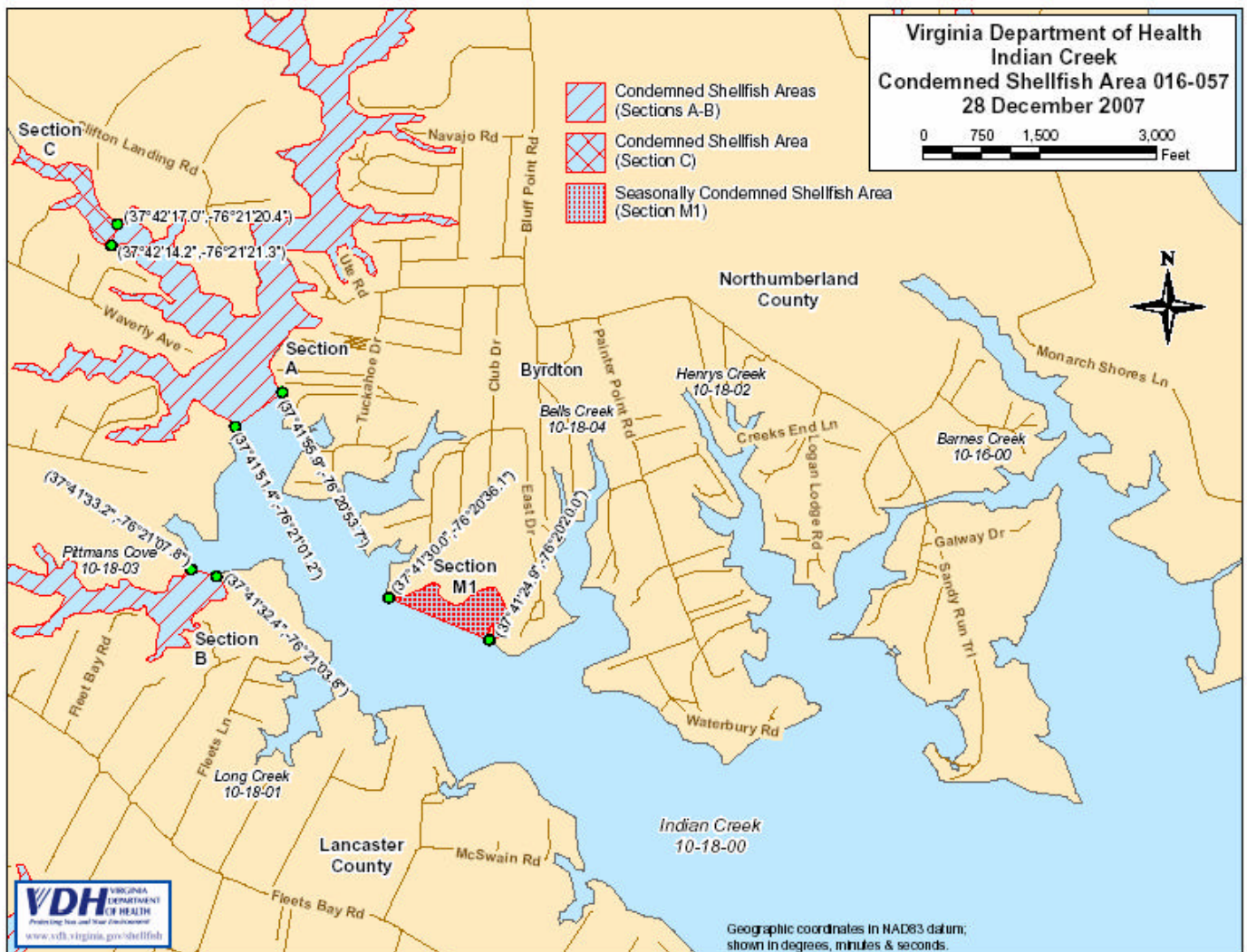
Ordered by:



State Health Commissioner

12/13/2001  
Date

# Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL





16  
raw Area



## COMMONWEALTH of VIRGINIA

Department of Health

RANDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 24, DYMER CREEK

**EFFECTIVE 5 MARCH 1997**

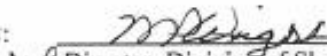
Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dyer Creek," effective 6 March 1995, is cancelled effective 5 March 1997.
2. Condemned Shellfish Area Number 24, Dyer Creek, is established, effective 5 March 1997. It shall be unlawful for any person, firm, or corporation to take shellfish from area #24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dyer Creek, Condemned Shellfish Area Number 24, 5 March 1997" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 24

- A. The condemned area shall include all of Dyer Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Flex" and "Cove."
- B. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn from a point located 626 feet (straight line distance) upstream from Marine Resources Commission survey marker "Whiegar" due east to the opposite shore.

Recommended by:

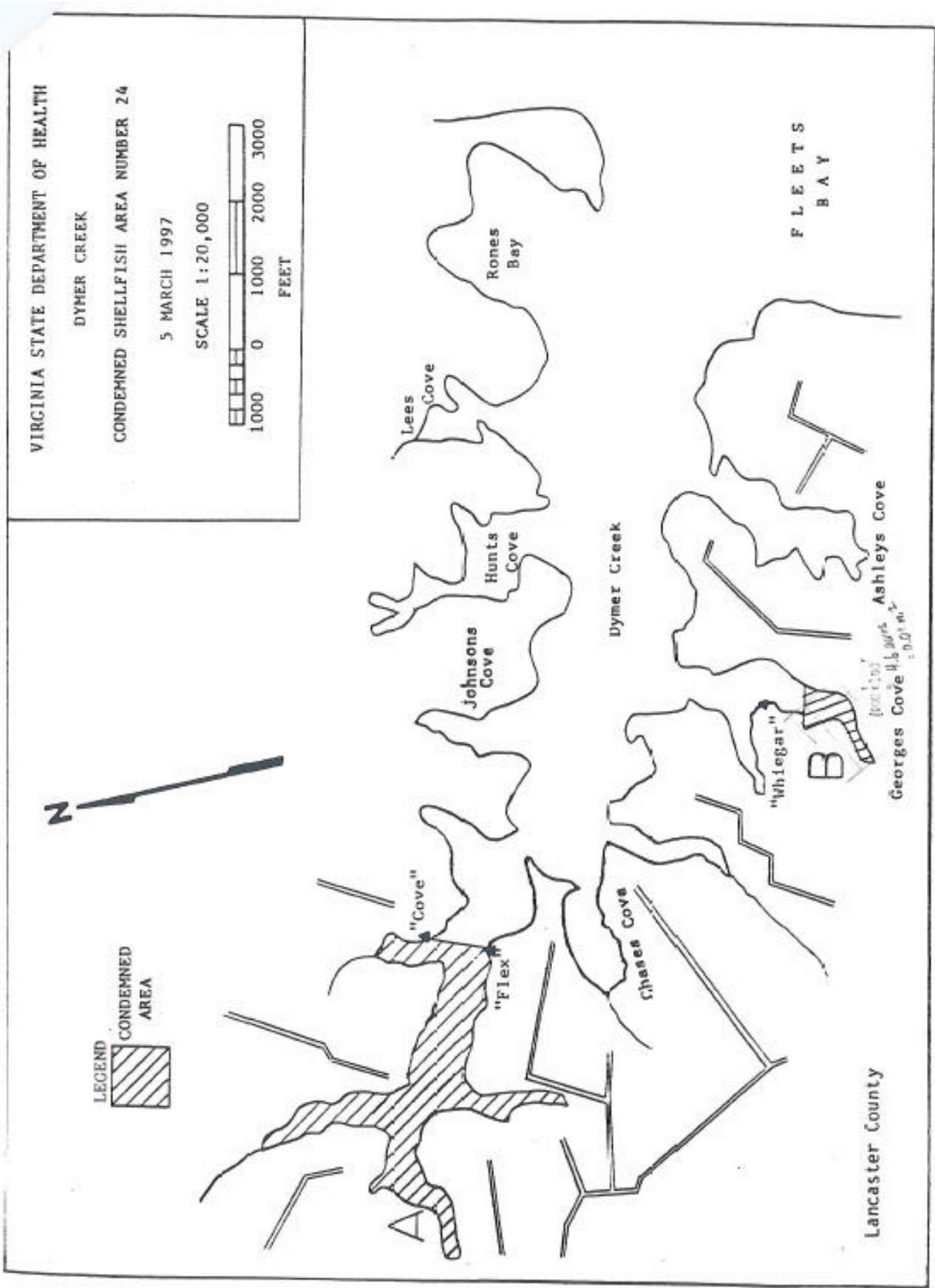
  
Director, Division of Shellfish Sanitation

Ordered by:

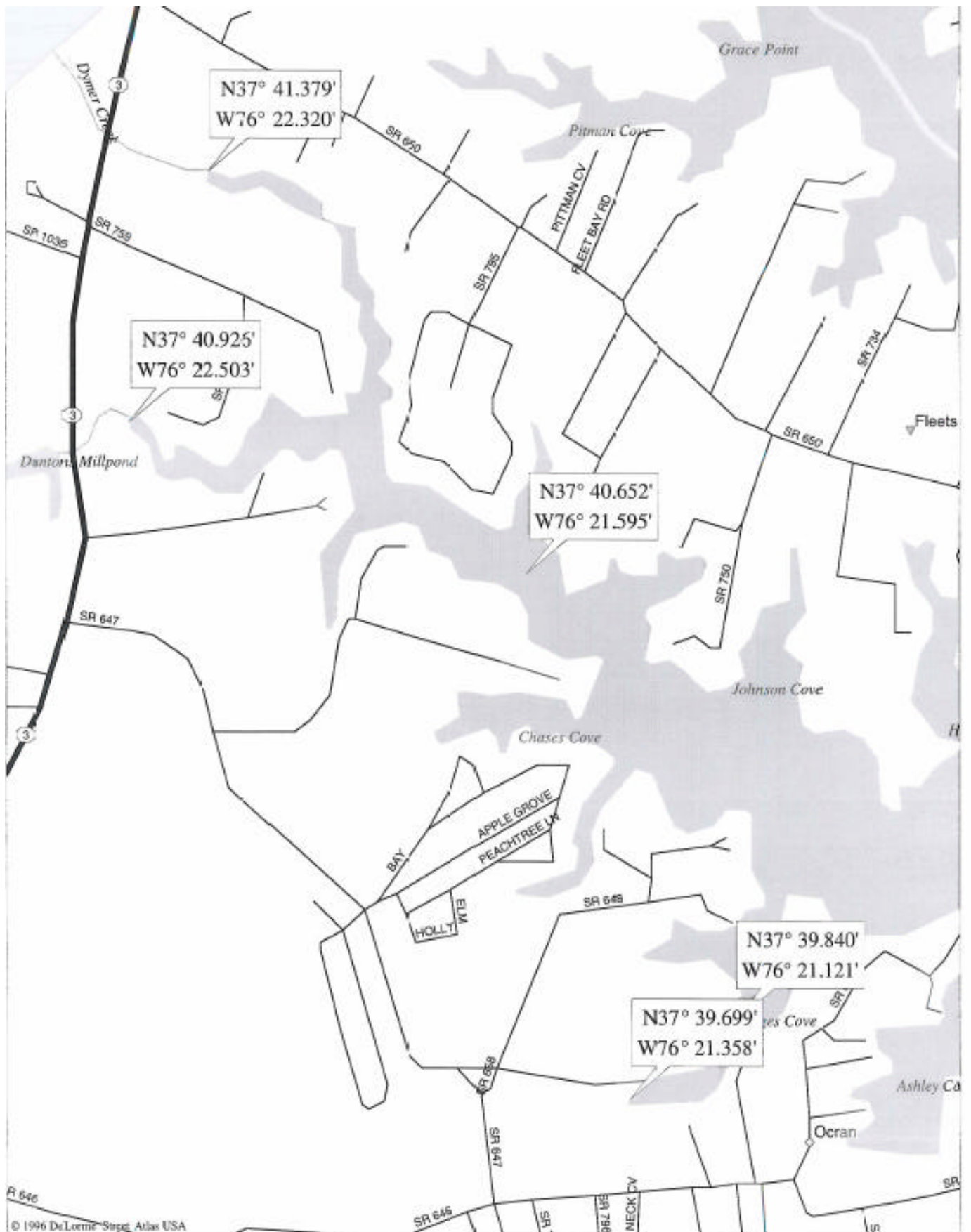
  
State Health Commissioner

  
Date

**VDH** VIRGINIA  
DEPARTMENT  
OF HEALTH  
Protecting You and Your Environment









## COMMONWEALTH of VIRGINIA

Department of Health

P O BOX 2448  
RICHMOND, VA 23218

TDC 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 24, DYMER CREEK

**EFFECTIVE 19 FEBRUARY 1999**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dyer Creek," effective 27 February 1998, is cancelled effective 19 February 1999.
2. Condemned Shellfish Area Number 24, Dyer Creek, is established, effective 19 February 1999. It shall be unlawful for any person, firm, or corporation to take shellfish from area #24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dyer Creek, Condemned Shellfish Area Number 24, 19 February 1999" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 24

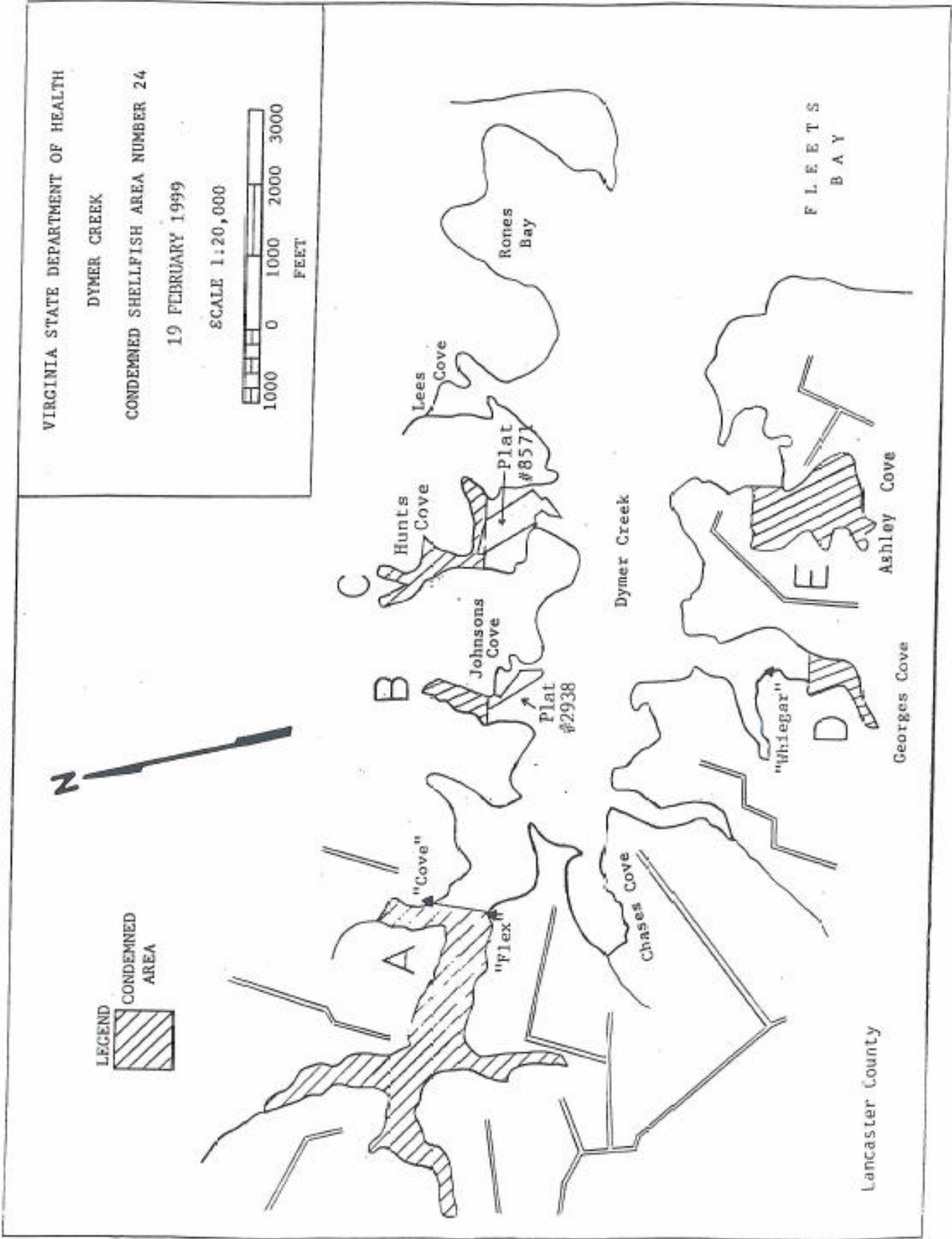
- A. The condemned area shall include all of Dyer Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Flex" and "Cove."
- B. The condemned area shall include all of that portion of Johnsons Cove and its tributaries lying upstream of a line drawn through the upstream boundary of plat #2938 to the opposite shore.
- C. The condemned area shall include all of Hunts Cove and its tributaries lying upstream of a line drawn from the northeast corner of plat #8571 due east-west to the opposite shores.
- D. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn from a point located 626 feet (straight line distance) upstream from Marine Resources Commission survey marker "Whiegar" due east to the opposite shore.

Shellfish Area Condemnation  
Number 24  
Page Two

- E. The condemned area shall include all of that portion of Ashley Cove and its tributaries lying upstream of a line drawn due south from the southeasternmost point of land on the western shore of Ashley Cove to the opposite shore.

Recommended by:   
Director, Division of Shellfish Sanitation

Ordered by:   
Acting State Health Commissioner Date







## COMMONWEALTH of VIRGINIA

Department of Health

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 24, DYMER CREEK

EFFECTIVE 21 JUNE 1999

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dymer Creek," effective 19 February 1999, is cancelled effective 21 June 1999.
2. Condemned Shellfish Area Number 24, Dymer Creek, is established, effective 21 June 1999. It shall be unlawful for any person, firm, or corporation to take shellfish from area #24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dymer Creek, Condemned Shellfish Area Number 24, 21 June 1999" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 24

The condemned area shall include all of Dymer Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Flex" and "Cove."

Recommended by:

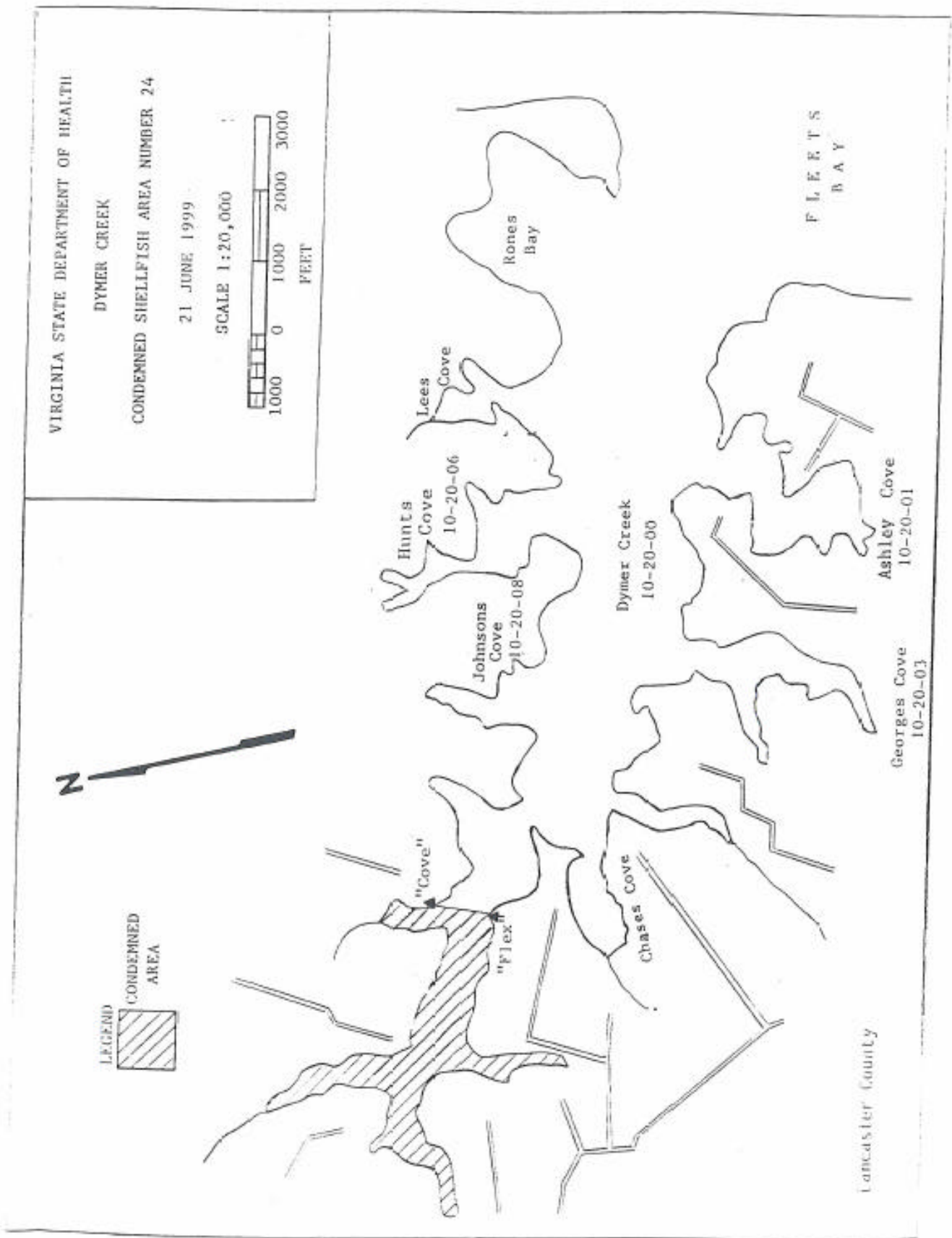
Director, Division of Shellfish Sanitation

Ordered by:

Acting State Health Commissioner

6/16/99  
Date

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JUL 06 2000

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## COMMONWEALTH of VIRGINIA

Department of Health

E. ANNE PETERSON, M.D., M.P.H.  
STATE HEALTH COMMISSIONER

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 24, DYMER CREEK

EFFECTIVE 14 JULY 2000

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dymer Creek," effective 21 June 1999, is cancelled effective 14 July 2000.
2. Condemned Shellfish Area Number 24, Dymer Creek, is established, effective 14 July 2000. It shall be unlawful for any person, firm, or corporation to take shellfish from area #24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dymer Creek, Condemned Shellfish Area Number 24, 14 July 2000" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 24

- A. The condemned area shall include all of Dymer Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Flex" and "Cove."
- B. The condemned area shall include all of Lees Cove and its tributaries lying upstream of a line drawn from the first point of land on the western shore upstream from Marine Resources Commission survey marker "Tip" southeasterly to the point of land on the opposite shore.
- C. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn from a point located 626 feet (straight line distance) upstream from Marine Resources Commission survey marker "Winegar" due east to the opposite shore.

Recommended by:

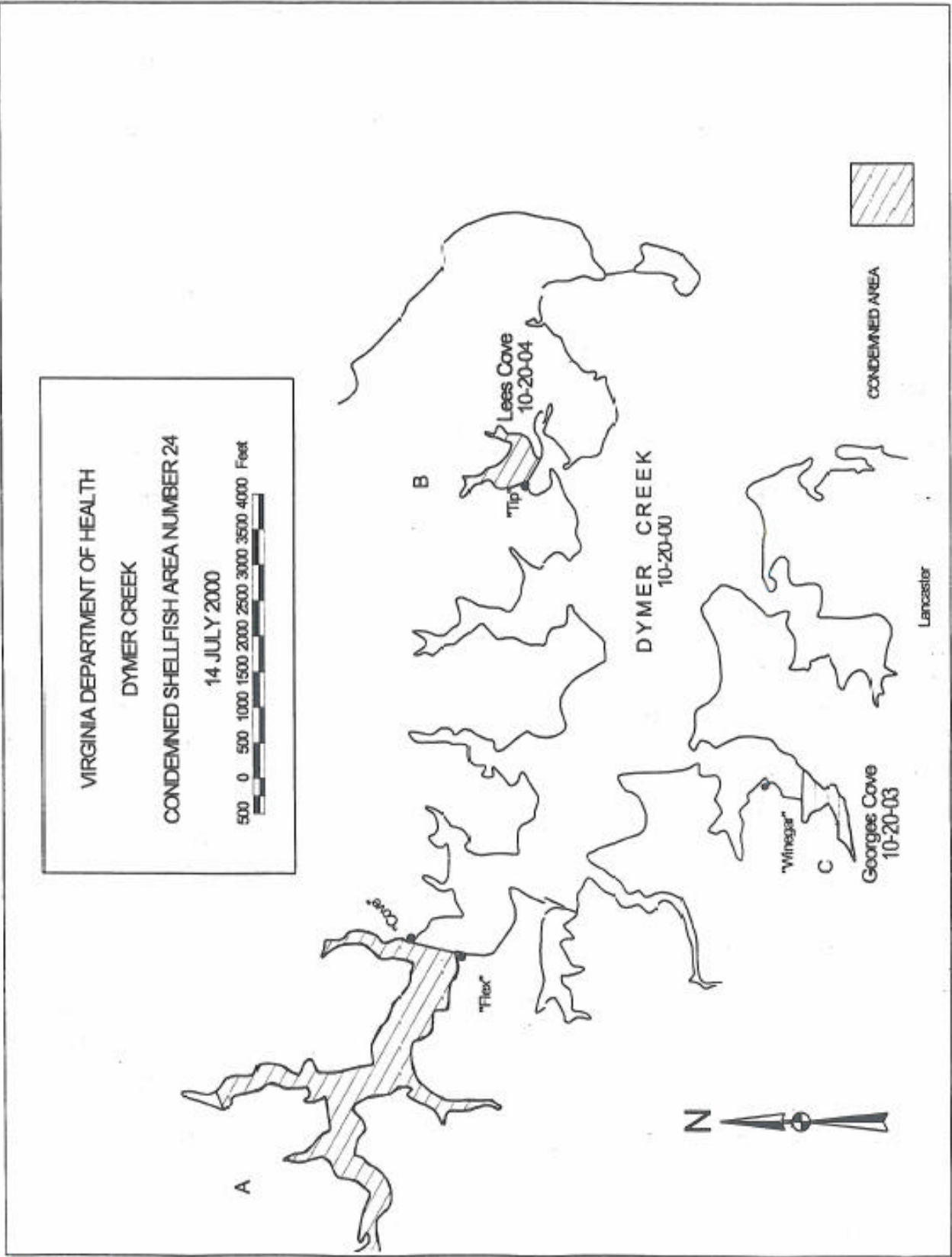
Robert E. Coonerburgh  
Director, Division of Shellfish Sanitation

Ordered by:

E. Anne Peterson M.D., M.P.H.  
State Health Commissioner

6/28/2000  
Date

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DEPARTMENT  
OF HEALTH  
Protecting You and Your Environment  
[www.vdh.state.va.us](http://www.vdh.state.va.us)







COMMONWEALTH of VIRGINIA

Department of Health  
Division of Shellfish Sanitation  
1500 East Main Street, Suite 109  
Richmond, Virginia 23219



(804) 786-7587  
Fax: (804) 786-5567

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 16-24, DYMER CREEK**

**EFFECTIVE 6 JANUARY 2004**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dyer Creek," effective 14 July 2000, is cancelled effective 6 January 2004.
2. The "Notice of Establishment and Description of Seasonally Condemned Shellfish Area at Marina Facility Designation M-62, Lancaster County," effective 13 April 1989 is cancelled effective 6 January 2004.
3. Condemned Shellfish Area Number 16-24, Dyer Creek, is established, effective 6 January 2004. It shall be unlawful for any person, firm, or corporation to take shellfish from area number 16-24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dyer Creek, Condemned Shellfish Area Number 16-24, 6 January 2004" which is part of this notice.
4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 16-24**

- A. The condemned area shall include all of Dyer Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'29.3", -76°21'17.9") and map coordinate (37°40'18.8", -76°21'19.7").
- B. The condemned area shall include all of Lees Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.2", -76°20'15.0") and map coordinate (37°40'24.6", -76°20'09.8").

Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

Shellfish Condemned Area Number 16-24  
Page 2

- C. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'56.5", -76°21'07.8") and map coordinate (37°40'01.1", -76°21'00.2").
- D. The condemned area shall include all of Johnson Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'29.2", -76°21'04.7") and map coordinate (37°40'31.8", -76°20'59.9").

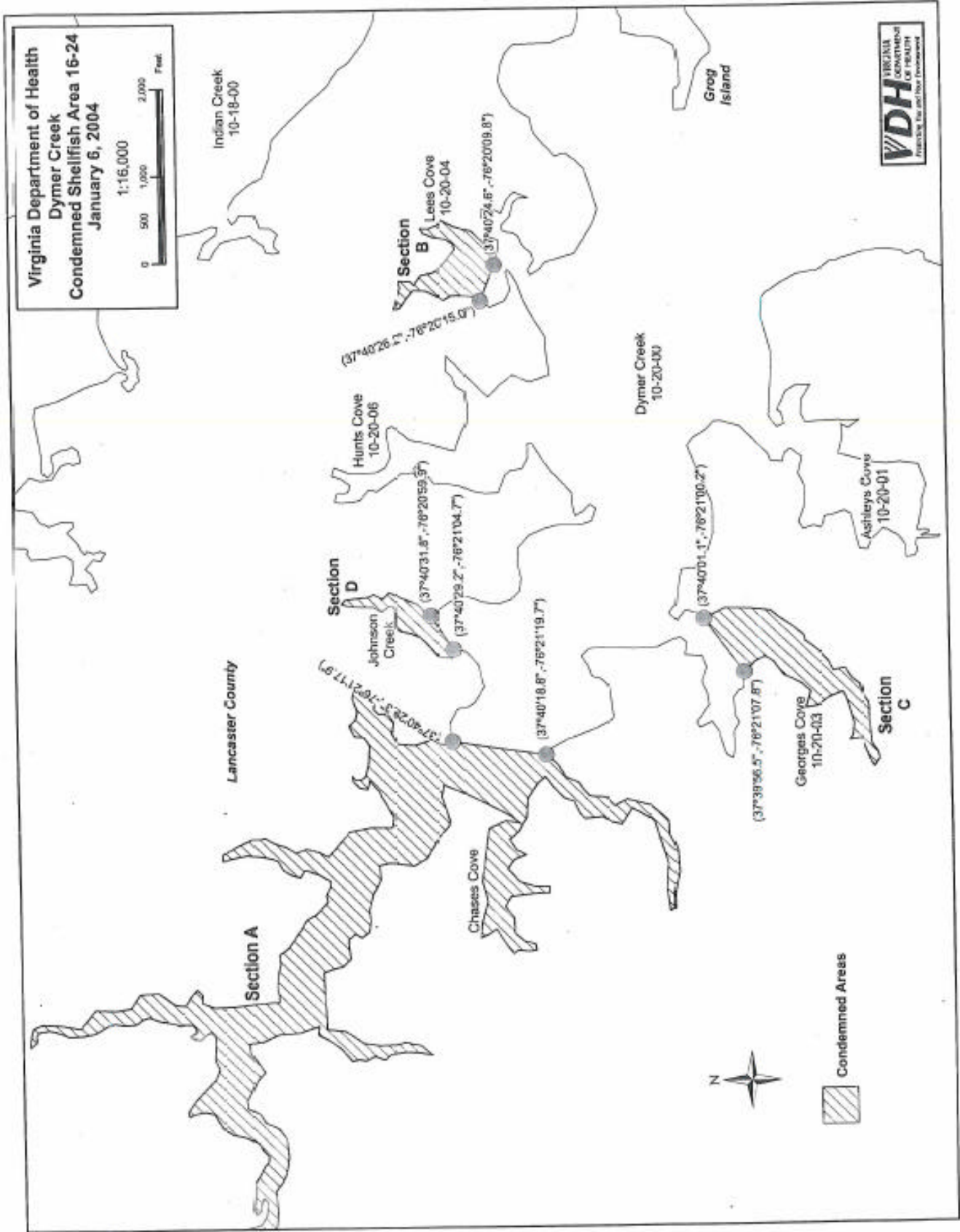
Recommended by:

  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

12/18/2003  
Date





REGISTER OF REGULATIONS

05 JAN 11 PM 4: 25

## COMMONWEALTH of VIRGINIA

Department of Health  
DIVISION OF SHELLFISH SANITATION  
109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 016-024, DYMER CREEK

EFFECTIVE 28 JANUARY 2005

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 016-024, Dyer Creek," effective 6 January 2004, is cancelled effective 28 January 2005.
2. Condemned Shellfish Area Number 016-024, shown as Sections A, B, C, D and E, is established, effective 28 January 2004. It shall be unlawful for any person, firm, or corporation to take shellfish from these sections for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of these sections are shown on the map titled "Dyer Creek, Condemned Shellfish Area Number 016-024, 28 January 2005" which is part of this notice.
4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 016-024


- A. The condemned area shall include all of Dyer Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'14.7", -76°21'05.7") and map coordinate (37°40'21.8", -76°20'55.8").
- B. The condemned area shall include all of Hunts Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'20.6", -76°20'37.0") and map coordinate (37°40'24.9", -76°20'29.0").
- C. The condemned area shall include all of Lees Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.2", -76°20'15.0") and map coordinate (37°40'24.6", -76°20'09.8").

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Shellfish Condemned Area #018-024  
Page 2

- D. The condemned area shall include all of Ashleys Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'51.4", -76°20'37.4") and map coordinate (37°39'52.6", -76°20'34.1").
- E. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'56.4", -76°21'07.8") and map coordinate (37°40'01.1", -76°21'00.2").

Recommended by:

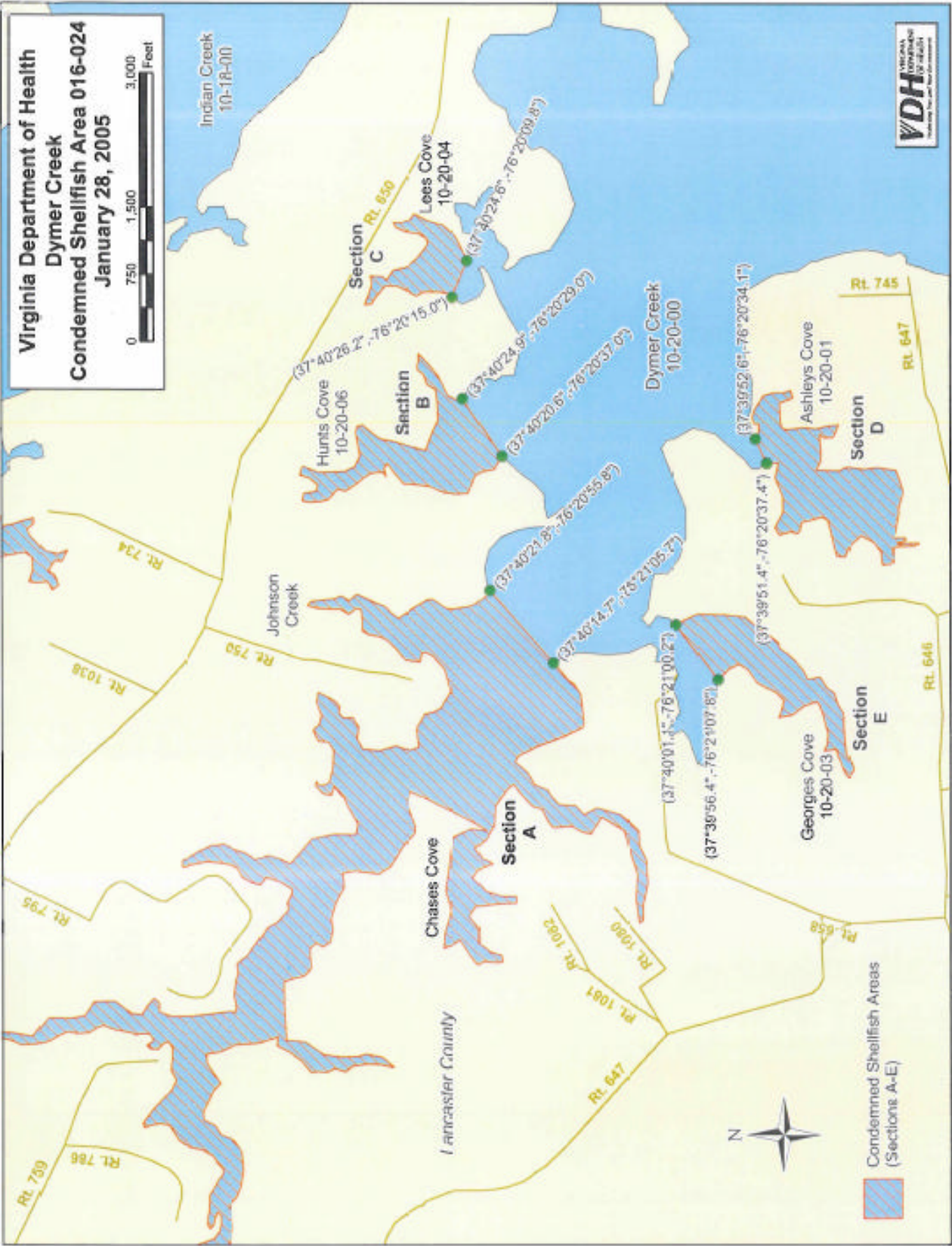
  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

01/14/2023  
Date





2008



REGISTRAR OF REGULATIONS

06 DEC -4 AM 10: 23

## COMMONWEALTH of VIRGINIA

Department of Health  
DIVISION OF SHELLFISH SANITATION

109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487

Fax: 804-864-7481

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 016-024, DYMER CREEK

EFFECTIVE 13 DECEMBER 2006

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 016-024, Dyer Creek," effective 28 January 2005, is cancelled effective 13 December 2006.
2. Condemned Shellfish Area Number 016-024, shown as Sections A, B, C, D, E and F, is established, effective 13 December 2006. It shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of these areas are shown on the map titled "Dyer Creek, Condemned Shellfish Area Number 016-024, 13 December 2006" which is part of this notice.
4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 016-024

- A. The condemned area shall include that portion of Dyer Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'30.1", -76°21'24.6") and map coordinate (37°40'29.7", -76°21'18.2").
- B. The condemned area shall include that portion of Hunts Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'20.6", -76°20'37.0") and map coordinate (37°40'24.9", -76°20'29.0").
- C. The condemned area shall include that portion of Lees Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.2", -76°20'15.0") and map coordinate (37°40'24.6", -76°20'09.8").

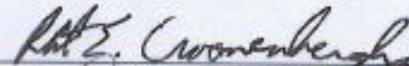
**VDH** VIRGINIA  
DEPARTMENT  
OF HEALTH  
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[www.vdh.virginia.gov/shellfish](http://www.vdh.virginia.gov/shellfish)



Shellfish Condemnation #016-024  
Page 2


- D. The condemned area shall include all of Johnson Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.5", -76°21'09.3") and map coordinate (37°40'23.4", -76°20'57.8").
- E. The condemned area shall include that portion of Georges Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'56.4", -76°21'07.8") and map coordinate (37°40'01.1", -76°21'00.2").
- F. The condemned area shall include all of Chases Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'30.1", -76°21'24.6") and map coordinate (37°40'18.9", -76°21'19.5").

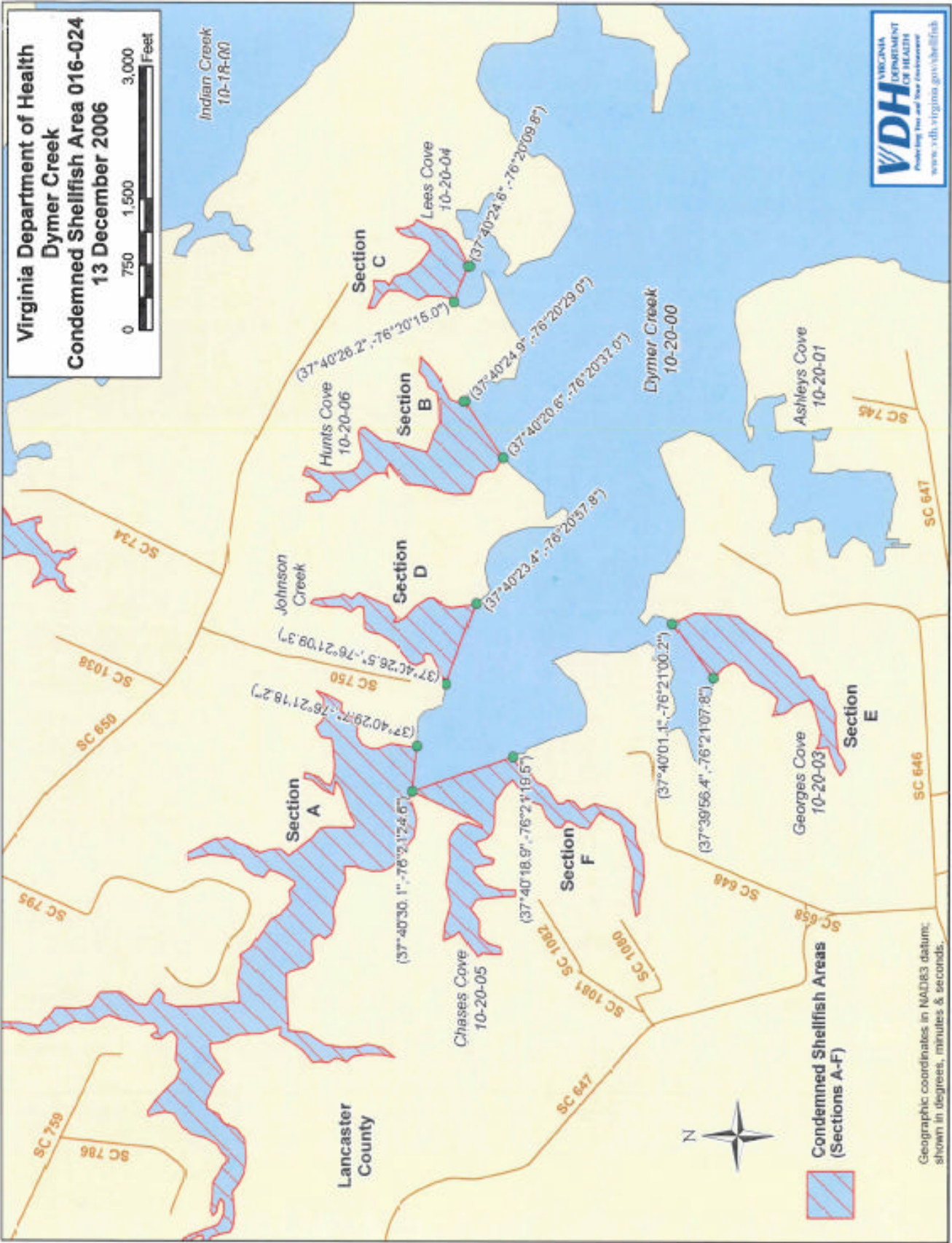
Recommended by:

  
\_\_\_\_\_  
Director, Division of Shellfish Sanitation

Ordered by:

  
\_\_\_\_\_  
State Health Commissioner

  
\_\_\_\_\_  
Date







REGISTRAR OF REGULATIONS

07 DEC 14 PM 2: 24

**COMMONWEALTH of VIRGINIA**

**Department of Health  
DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-024, DYMER CREEK**

**EFFECTIVE 28 DECEMBER 2007**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 016-024, Dyer Creek," effective 13 December 2006, is cancelled effective 28 December 2007.
2. Condemned Shellfish Area Number 016-024, shown as Sections A, B, C, and D, is established, effective 28 December 2007. It shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of these areas are shown on the map titled "Dyer Creek, Condemned Shellfish Area Number 016-024, 28 December 2007" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-024**

- A. The condemned area shall include that portion of Dyer Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'30.1", -76°21'24.6") and map coordinate (37°40'29.7", -76°21'18.2").
- B. The condemned area shall include all of Chases Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'30.1", -76°21'24.6") and map coordinate (37°40'18.9", -76°21'19.5").
- C. The condemned area shall include that portion of Lees Cove and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.2", -76°20'15.0") and map coordinate (37°40'24.6", -76°20'09.8").

**VDH** VIRGINIA  
DEPARTMENT  
OF HEALTH  
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[www.vdh.virginia.gov/shellfish](http://www.vdh.virginia.gov/shellfish)

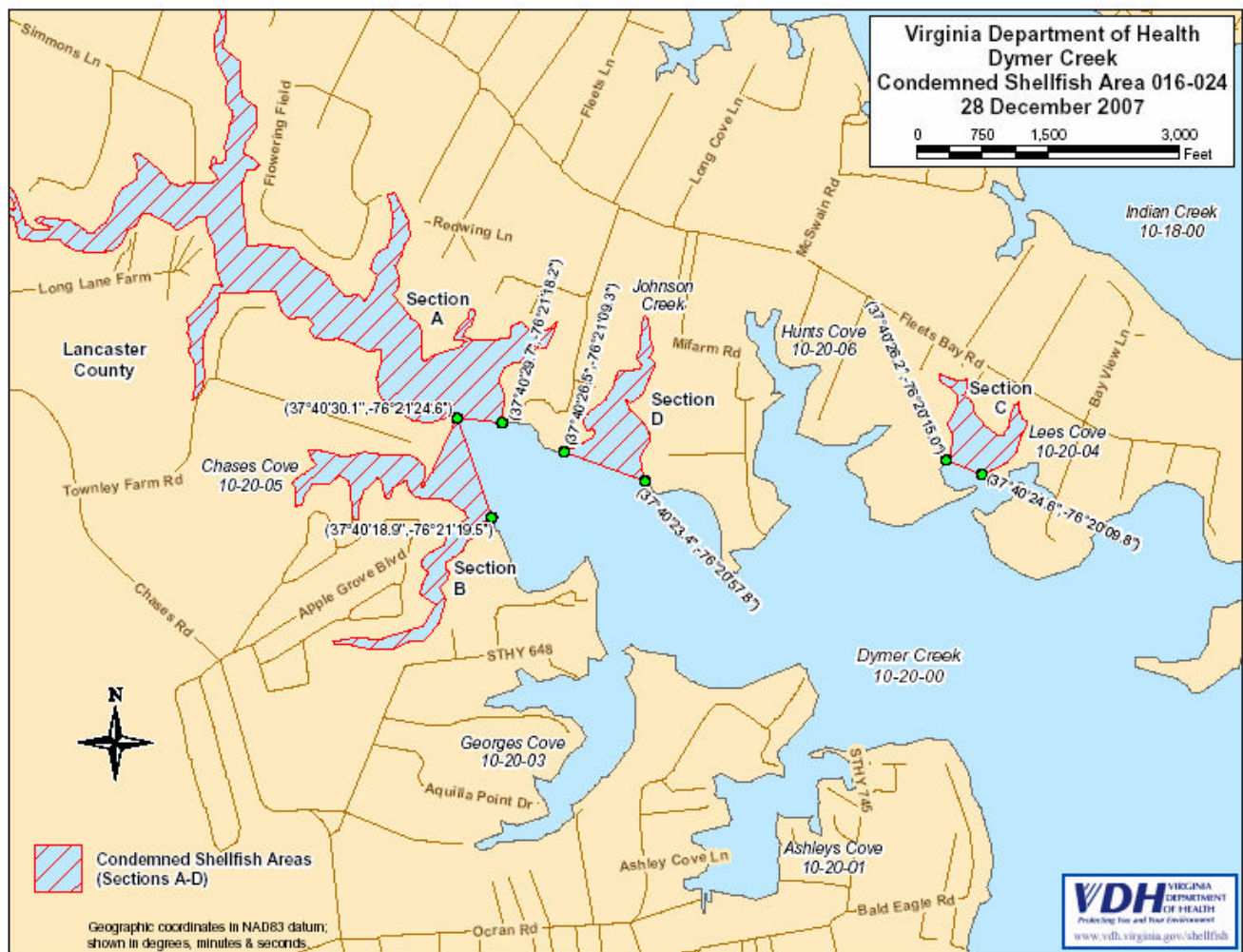
Shellfish Condemnation #016-024  
Page 2

- D. The condemned area shall include all of Johnson Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°40'26.5", -76°21'09.3") and map coordinate (37°40'23.4", -76°20'57.8").

Recommended by: M. E. Lovernberg  
Director, Division of Shellfish Sanitation

Ordered by: Paul B. Dwyer 12/13/2007  
State Health Commissioner Date

# Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL







## COMMONWEALTH of VIRGINIA

RAMDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER

Department of Health  
Office of Water Programs  
Division of Shellfish Sanitation  
1500 East Main Street, Suite 109  
Richmond, Virginia 23219-3635

PHONE (804) 786-7937  
FAX (804) 786-5567

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 24, DYMER CREEK

EFFECTIVE 27 FEBRUARY 1998

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, E.16 of the *Code of Virginia*.

1. The "Notice and Description of Shellfish Area Condemnation Number 24, Dyer Creek," effective 5 March 1997, is cancelled effective 27 February 1998.
2. Condemned Shellfish Area Number 24, Dyer Creek, is established, effective 27 February 1998. It shall be unlawful for any person, firm, or corporation to take shellfish from area #24 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Dyer Creek, Condemned Shellfish Area Number 24, 27 February 1998" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 24

- A. The condemned area shall include all of Dyer Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Flex" and "Cove."
- B. The condemned area shall include all of Georges Cove and its tributaries lying upstream of a line drawn from a point located 626 feet (straight line distance) upstream from Marine Resources Commission survey marker "Whiegar" due east to the opposite shore.



Shellfish Area Condemnation  
Number 24  
Page Two

- C. The condemned area shall include all of Hunts Cove and its tributaries lying upstream of a line drawn from the northeast corner of plat #8571 due east-west to the opposite shores.

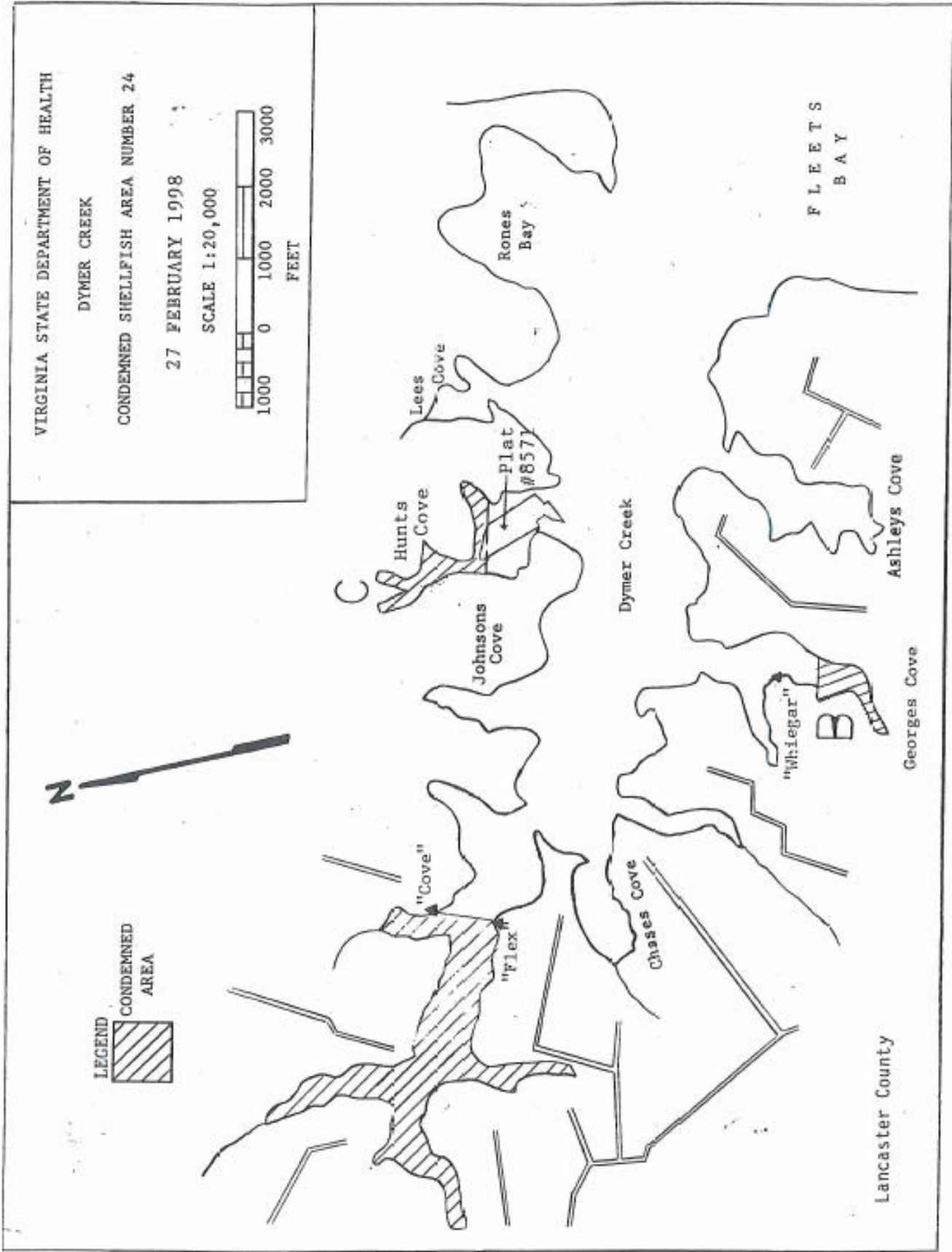
Recommended by:

*W. E. Croonenburg*  
Director, Division of Shellfish Sanitation

Ordered by:

*Carl W. Armstrong* *2/17/98*  
State Health Commissioner Date

**SIGNED PURSUANT TO  
AUTHORITY VESTED IN  
DEPUTY HEALTH COMMISSIONER  
BY §2.1-20-01:2; CODE OF VA**



16  
Grow Area



## COMMONWEALTH of VIRGINIA

Department of Health

RANDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER

P O BOX 2448  
RICHMOND, VA. 23218

TDD 1-800-828-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 133, TABBS CREEK

EFFECTIVE 5 MARCH 1997

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 133, Tabbs Creek," effective 13 March 1996, is cancelled effective 5 March 1997.
2. Condemned Shellfish Area Number 133, Tabbs Creek, is established, effective 5 March 1997. It shall be unlawful for any person, firm, or corporation to take shellfish from area #133 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Tabbs Creek, Condemned Shellfish Area Number 133, 5 March 1997" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 133

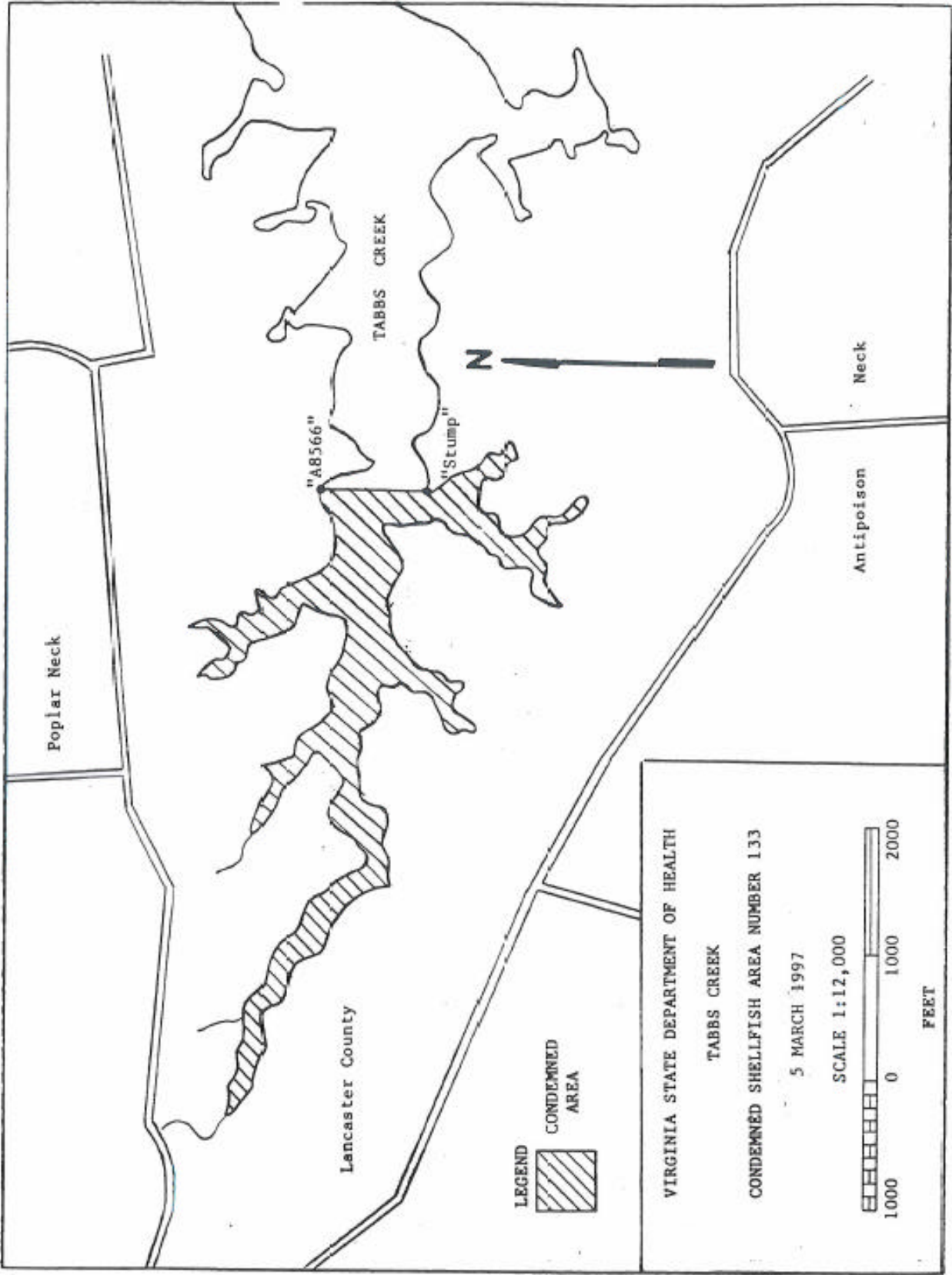
The condemned area shall include all of Tabbs Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "A8566" and "Stump."

Recommended by: *Dr. Gordon*  
for Director, Division of Shellfish Sanitation

Ordered by: *Randy Gordon* by *Dr. Gordon* 2-20-97  
State Health Commissioner Deputy Date









Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL





# COMMONWEALTH of VIRGINIA

Department of Health

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-828-1120

## NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 133, TABBS CREEK

EFFECTIVE 21 JUNE 1999

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 133, Tabbs Creek," effective 5 March 1997, is cancelled effective 21 June 1999.
2. Condemned Shellfish Area Number 133, Tabbs Creek, is established, effective 21 June 1999. It shall be unlawful for any person, firm, or corporation to take shellfish from area #133 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Tabbs Creek, Condemned Shellfish Area Number 133, 21 June 1999" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 133

The condemned area shall include all of that portion of Tabbs Creek and its tributaries lying upstream of a line drawn from a point 780 feet (straight line distance) upstream of Marine Resources Commission survey marker "Cornilius" on the south shore due north to the opposite shore.

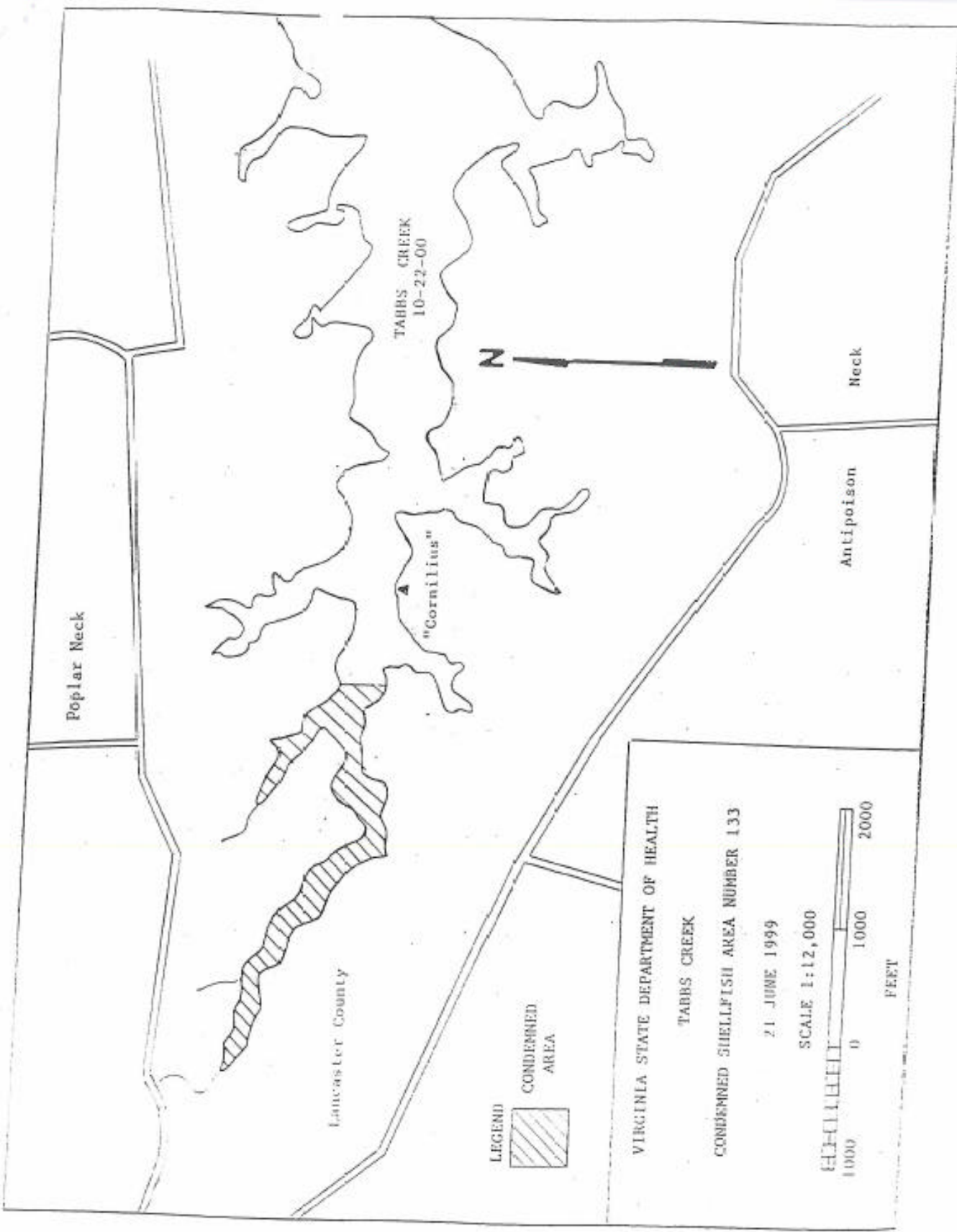
Recommended by:

Robert E. Croonerbaugh  
Director, Division of Shellfish Sanitation

Ordered by:

James P. Smith, MD, MPH  
Acting State Health Commissioner

6/21/99  
Date





## COMMONWEALTH of VIRGINIA

Department of Health

E. ANNE PETERSON, M.D., M.P.H.  
STATE HEALTH COMMISSIONER

P O BOX 2448  
RICHMOND, VA 23218

TDD 1-800-628-1120

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 133, TABBS CREEK

EFFECTIVE 14 JULY 2000

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 133, Tabbs Creek," effective 21 June 1999, is cancelled effective 14 July 2000.
2. Condemned Shellfish Area Number 133, Tabbs Creek, is established, effective 14 July 2000. It shall be unlawful for any person, firm, or corporation to take shellfish from area #133 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Tabbs Creek, Condemned Shellfish Area Number 133, 14 July 2000" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 133

The condemned area shall include all of Tabbs Creek and its tributaries lying upstream of a line drawn due north from the point of land on the opposite downstream shore located northeast of Marine Resources Commission survey marker "Marsh."

Recommended by:

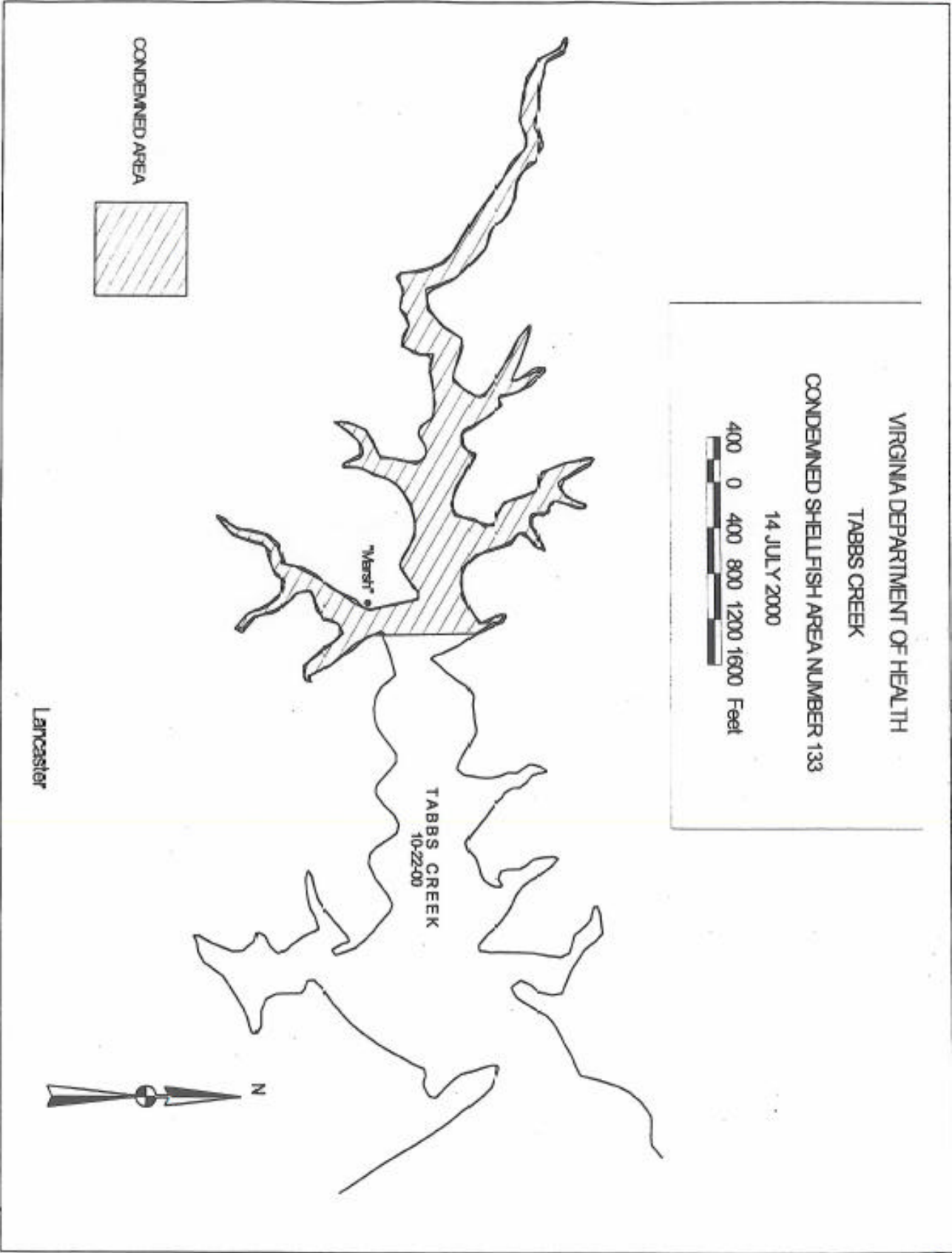
  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

  
Date







RECEIVED  
NOV 27 2002  
PRO



## COMMONWEALTH of VIRGINIA

Department of Health  
Division of Shellfish Sanitation  
1500 East Main Street, Suite 109  
Richmond, Virginia 23219

(804) 786-7937  
Fax: (804) 786-5567

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 133, TABBS CREEK

EFFECTIVE 6 DECEMBER 2002

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 133, Tabbs Creek," effective 14 July 2000, is cancelled effective 6 December 2002.
2. Condemned Shellfish Area Number 133, Tabbs Creek, is established, effective 6 December 2002. It shall be unlawful for any person, firm, or corporation to take shellfish from area #133 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Tabbs Creek, Condemned Shellfish Area Number 133, 6 December 2002" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

### BOUNDARIES OF CONDEMNED AREA NUMBER 133

The condemned area shall include all of Tabbs Creek and its tributaries lying upstream of a line drawn due north-south through a point located 350 feet westerly along the southern boundary from the southeast corner of Plat #7311 to the opposite shores.

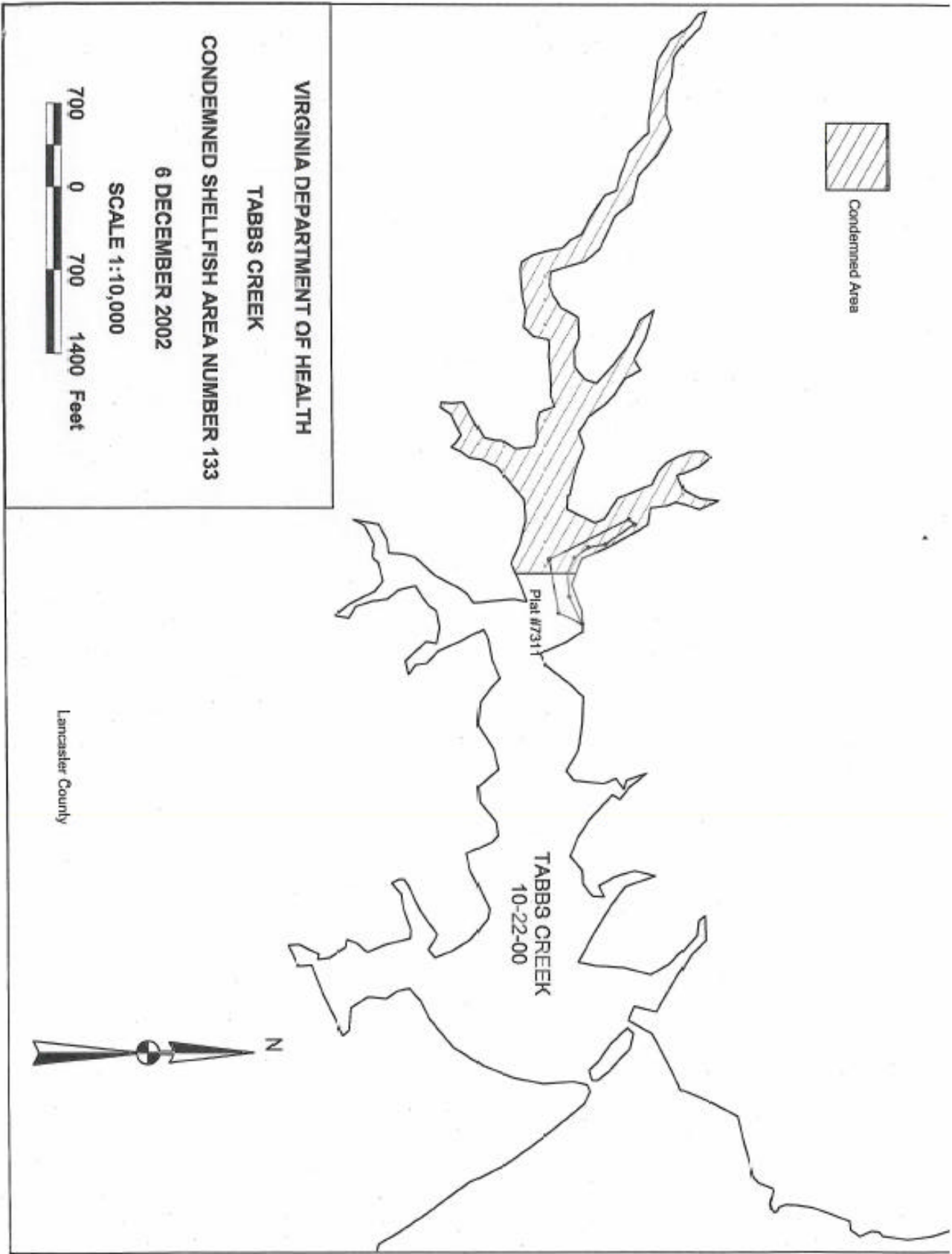
Recommended by:

Director, Division of Shellfish Sanitation

Ordered by:

State Health Commissioner

Date





REGISTRAR OF REGULATIONS  
05 JAN 11 PM 4:26

**COMMONWEALTH of VIRGINIA**

*Department of Health*  
**DIVISION OF SHELLFISH SANITATION**  
109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-664-7487  
Fax: 804-664-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-133, TABBS CREEK**

**EFFECTIVE 28 JANUARY 2005**

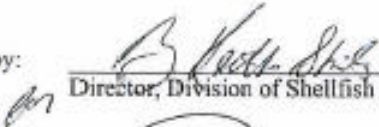
Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 133, Tabbs Creek," effective 6 December 2002, is cancelled effective 28 January 2005.
2. Condemned Shellfish Area Number 016-133, shown as Section A, is established, effective 28 January 2005. It shall be unlawful for any person, firm, or corporation to take shellfish from this section for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundary of this section is shown on the map titled "Tabbs Creek, Condemned Shellfish Area Number 016-133, 28 January 2005" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-133**

- A. The condemned area shall include all of Tabbs Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'12.5", -76°20'48.1") and map coordinate (37°39'06.0", -76°20'42.0").

Recommended by:

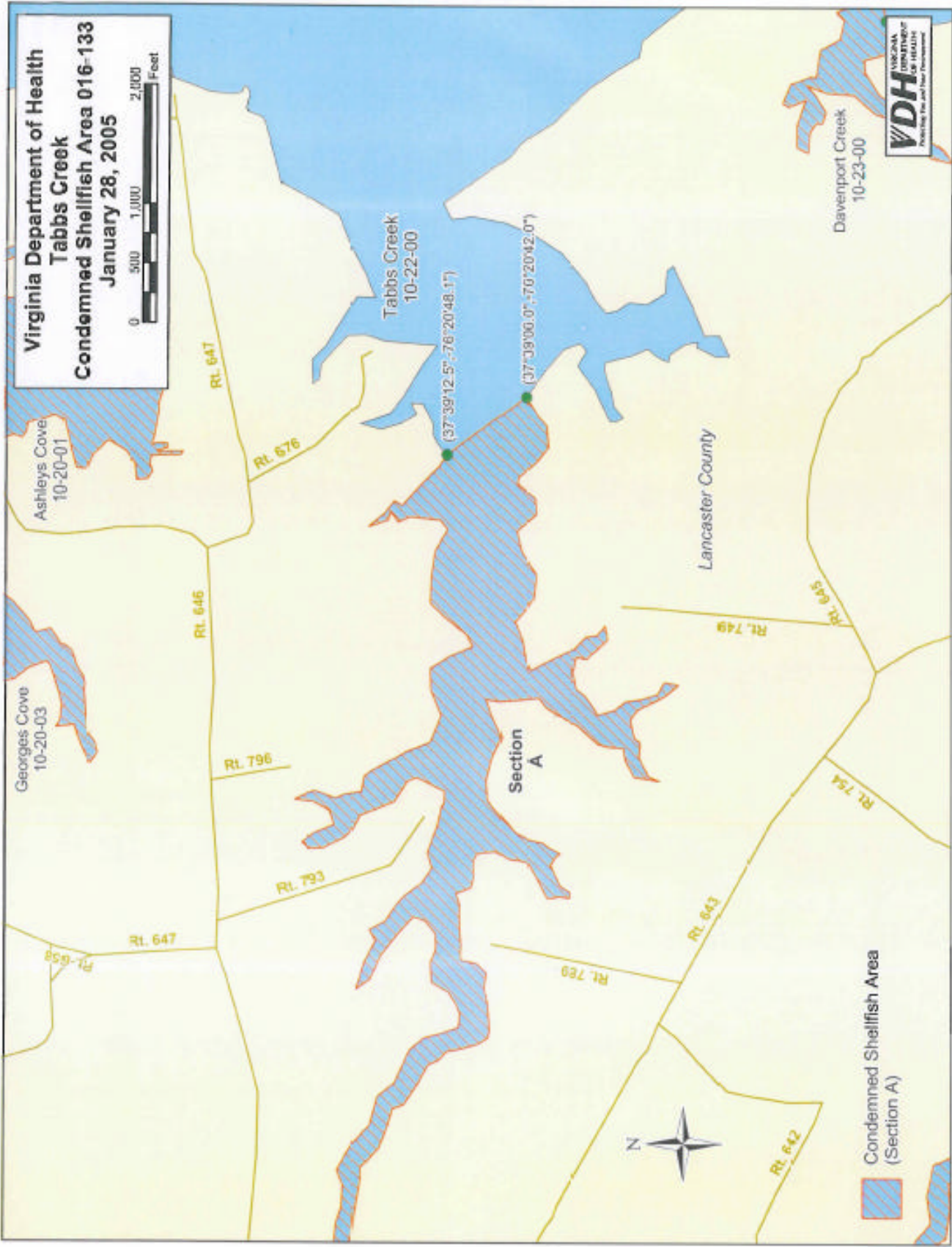
  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

  
Date





2008



**COMMONWEALTH of VIRGINIA**

**Department of Health  
DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

REGISTRAR OF REGULATIONS  
06 DEC -4 AM 10:23

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-133, TABBS CREEK**

**EFFECTIVE 13 DECEMBER 2006**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-5.14:4-1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 016-133, Tabbs Creek," effective 28 January 2005, is cancelled effective 13 December 2006.
2. Condemned Shellfish Area Number 016-133, shown as Section A, is established effective 13 December 2006. It shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundary of this area is shown on the map titled "Tabbs Creek, Condemned Shellfish Area Number 016-133, 13 December 2006" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-133**

- A. The condemned area shall include that portion of Tabbs Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'13.5", -76°20'36.6") and map coordinate (37°39'03.3", -76°20'27.0").

Recommended by:

Director, Division of Shellfish Sanitation

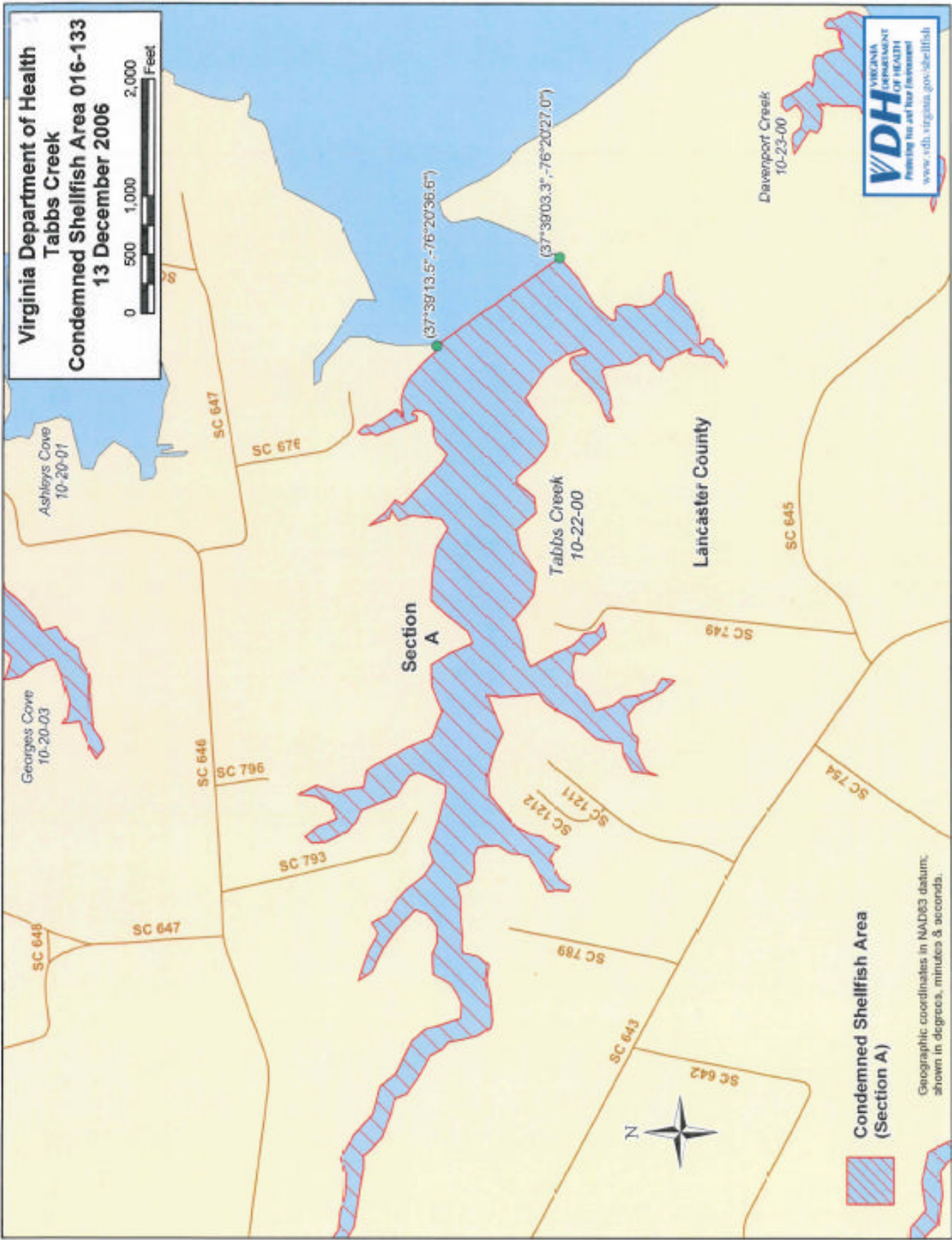
Ordered by:

State Health Commissioner

12/1/06  
Date

**VDH** VIRGINIA  
DEPARTMENT  
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**COMMONWEALTH of VIRGINIA**

*Department of Health*  
**DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 016-133, TABBS CREEK**

**EFFECTIVE 28 DECEMBER 2007**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 016-133, Tabbs Creek," effective 13 December 2006, is cancelled effective 28 December 2007.
2. Condemned Shellfish Area Number 016-133, shown as Section A, is established effective 28 December 2007. It shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundary of this area is shown on the map titled "Tabbs Creek, Condemned Shellfish Area Number 016-133, 28 December 2007" which is a part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 016-133**

- A. The condemned area shall include that portion of Tabbs Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°39'10.2", -76°21'08.5") and map coordinate (37°39'06.7", -76°21'06.8").

Recommended by:

Director, Division of Shellfish Sanitation

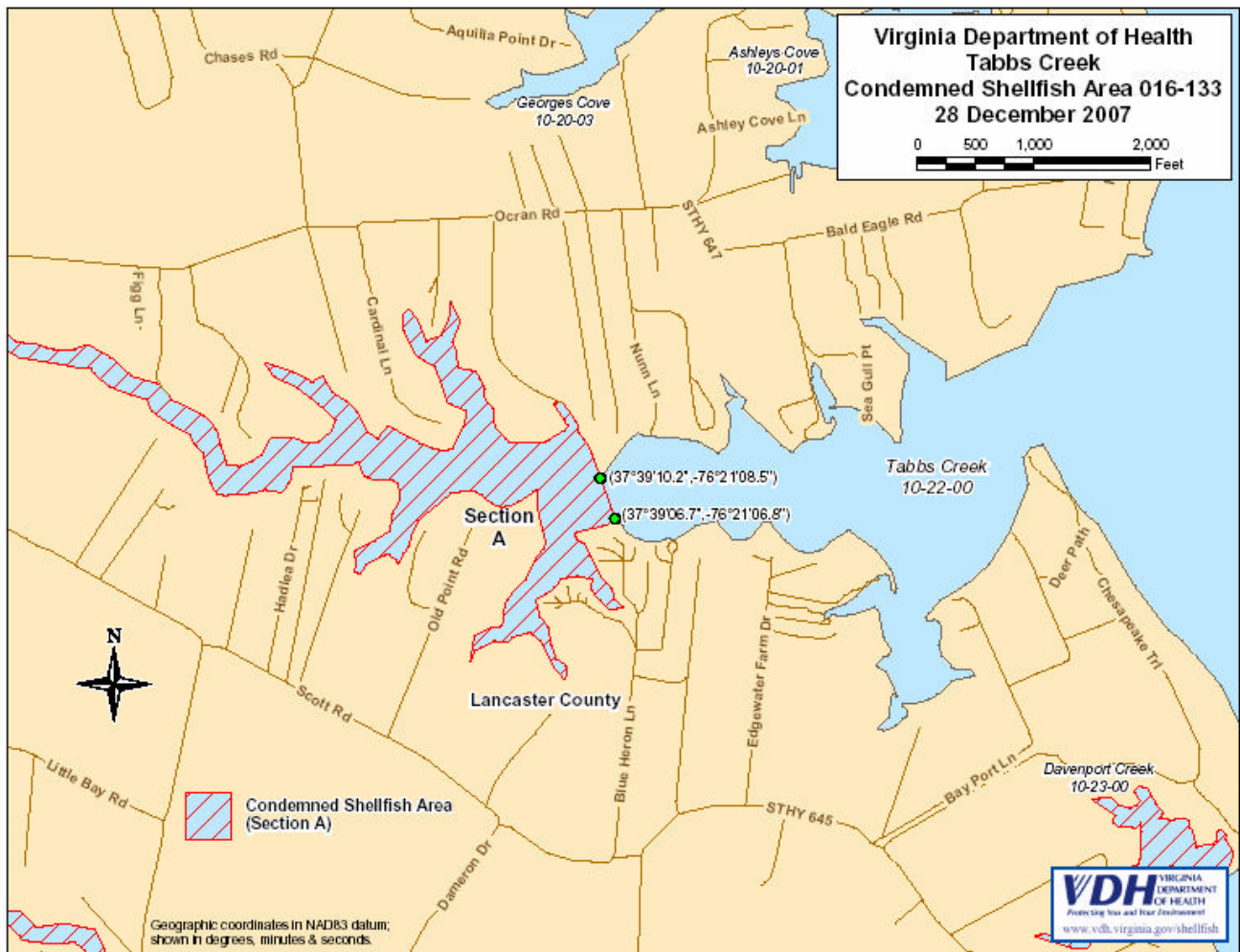
Ordered by:

State Health Commissioner

12/13/2007  
Date

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Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL







COMMONWEALTH of VIRGINIA

Department of Health

P O BOX 2448

RICHMOND, VA 23218

RANDOLPH L. GORDON, M.D., M.P.H.  
COMMISSIONER



TDD 1-800-828-1120

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 188, ANTIPOISON CREEK

EFFECTIVE 3 JUNE 1996

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. Condemned Shellfish Area Number 188, Antipoison Creek, is established, effective 3 June 1996. It shall be unlawful for any person, firm, or corporation to take shellfish from area #188 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Antipoison Creek, Condemned Shellfish Area Number 188, 3 June 1996" which is part of this notice.
2. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 188

The condemned area shall include all of Antipoison Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Chilton" due northwest to the opposite shore.

RECEIVED

MAY 29 1996

Recommended by: [Signature]  
Director, Division of Shellfish Sanitation

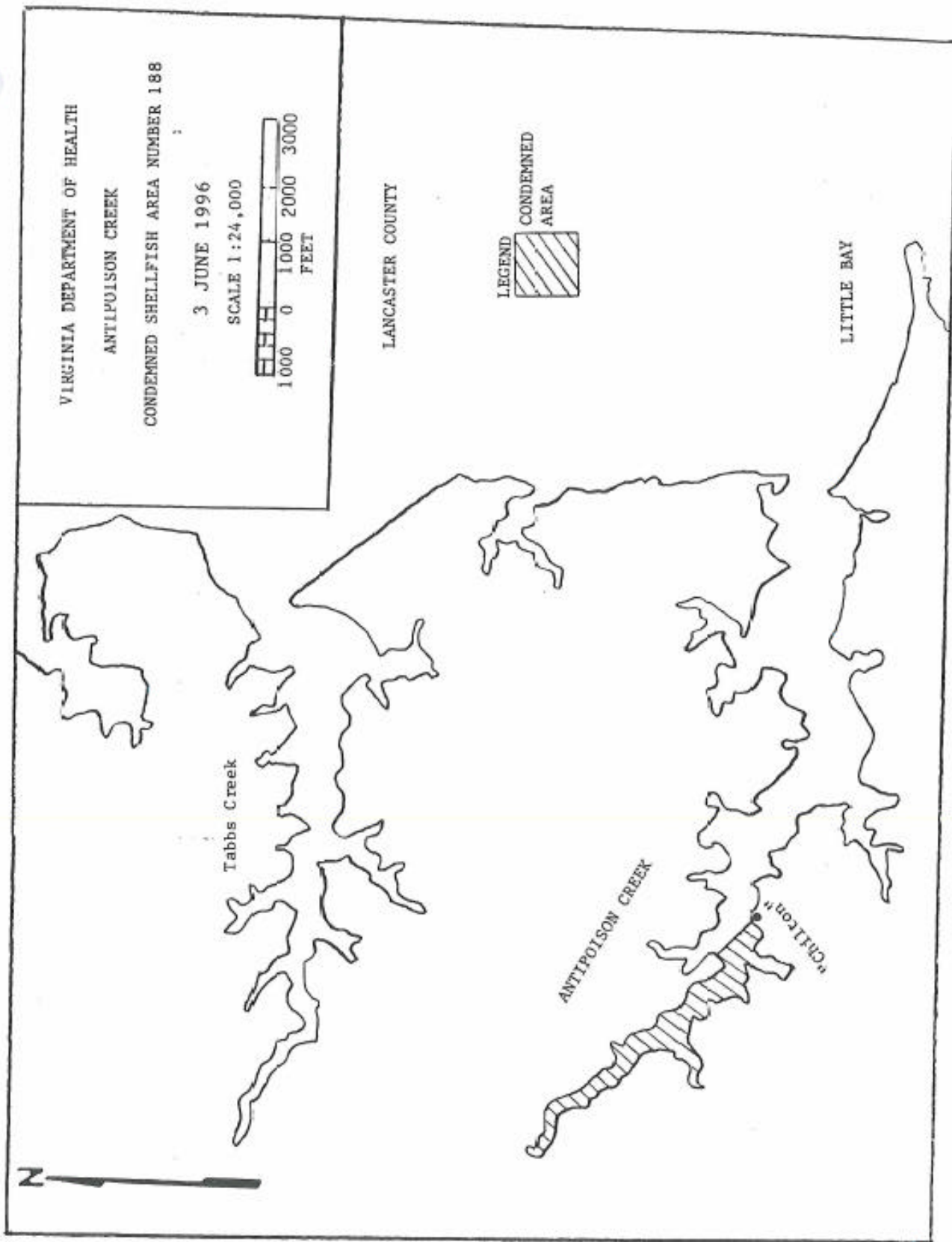
DEQ TRO

Ordered by:

[Signature]  
State Health Commissioner

Date

**VDH** VIRGINIA  
DEPARTMENT  
OF HEALTH  
Protecting You and Your Environment







**COMMONWEALTH of VIRGINIA**

*Department of Health*  
**DIVISION OF SHELLFISH SANITATION**  
109 Governor Street, Room 614-B  
Richmond, VA 23219

2006  
**RECEIVED**

JUL 01 2004

**PRO**

Ph: 804-864-7487  
Fax: 804-864-7481

**NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION  
NUMBER 017-188, ANTIPOISON CREEK**

**EFFECTIVE 13 JULY 2004**

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 188, Antipoison Creek," effective 5 May 2003 has been cancelled effective 13 July 2004.
2. The "Notice of Establishment and Description of Seasonally Condemned Shellfish Area at Marina Facility Designation M-74, Lancaster County," effective 1 April 1995 is cancelled effective 13 July 2004.
3. The "Notice of Establishment and Description of Seasonally Condemned Shellfish Area at Marina Facility Designation M-75, Lancaster County," effective 1 April 1995 is cancelled effective 13 July 2004.
4. Condemned Shellfish Area Number 017-188, Antipoison Creek, is established, effective 13 July 2004. It shall be unlawful for any person, firm, or corporation to take shellfish from area Number 017-188 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of the area are shown on map titled "Antipoison Creek, Condemned Shellfish Area Number 017-188, 13 July 2004" which is part of this notice.
6. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

**BOUNDARIES OF CONDEMNED AREA NUMBER 017-188**

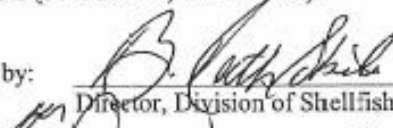
- A. The condemned area shall include all of Antipoison Creek and its tributaries lying upstream of a line drawn from latitude/longitude map coordinate (37°37'49.9", -76°19'58.1") to map coordinate (37°37'55.9", -76°19'54.5").

Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

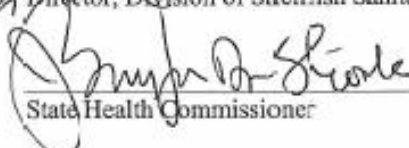
Shellfish Condemnation Area # 017-138  
Page 2

- B. The condemned area shall include all of Davenport Creek and its tributaries lying upstream of a line drawn from latitude/longitude map coordinate (37°38'36.7", -76°20'01.9") to map coordinate (37°38'37.1", -76°19'59.8").

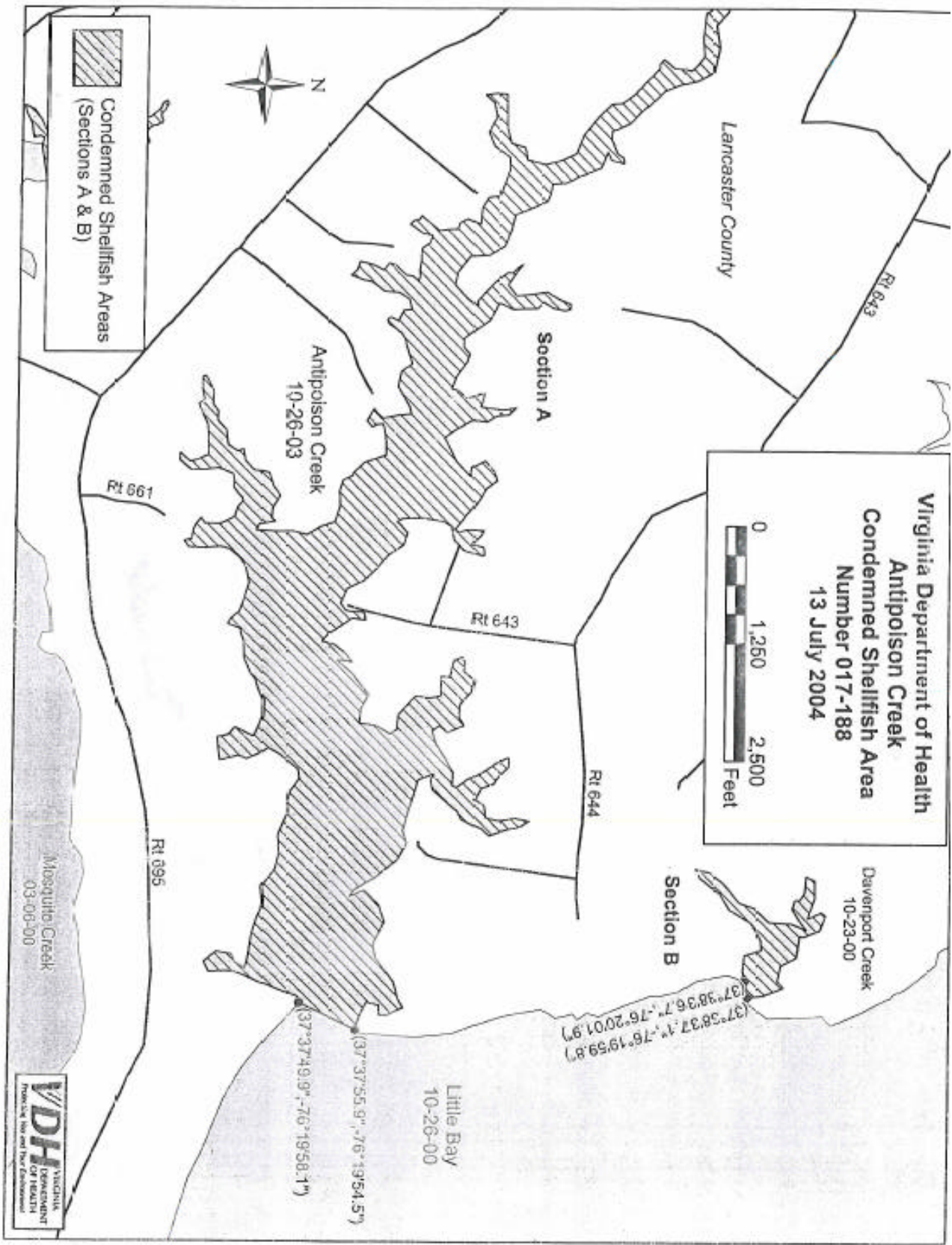
Recommended by:

  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

6/28/04  
Date





2008



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## COMMONWEALTH of VIRGINIA

Department of Health  
DIVISION OF SHELLFISH SANITATION  
109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

### NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 017-188, ANTIPOISON CREEK

EFFECTIVE 1 MAY 2006

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-5.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 017-188, Antipoison Creek," effective 13 July 2004 has been cancelled effective 1 May 2006.
2. Condemned Shellfish Area Number 017-188, shown as Sections A, B, C and D, is established effective 1 May 2006. It shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commissioner, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of these areas are shown on the map titled "Antipoison Creek, Condemned Shellfish Area Number 017-188, 1 May 2006" which is part of this notice.
3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

#### BOUNDARIES OF CONDEMNED AREA NUMBER 017-188

- A. The condemned area shall include all of Davenport Creek and its tributaries lying upstream of a line drawn from latitude/longitude map coordinate (37°38'37.4", -76°20'03.2") to map coordinate (37°38'36.3", -76°20'03.5").
- B. The condemned area shall include all of the unnamed tributary found along the north bank of Antipoison Creek lying upstream of a line drawn from latitude / longitude map coordinate (37°38'01.5", -76°20'28.2") to map coordinate (37°37'59.0", -76°20'34.2").
- C. The condemned area shall include that portion of Antipoison Creek and its tributaries lying upstream of a line drawn from latitude / longitude map coordinate (37°37'52.6", -76°20'52.3") to map coordinate (37°37'43.4", -76°20'55.1").

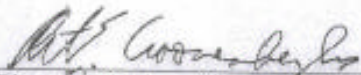
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[www.vdh.virginia.gov/shellfish](http://www.vdh.virginia.gov/shellfish)

Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL


Shellfish Condemnation Area # 017-188  
Page 2

- D. The condemned area shall include all of the unnamed tributary found along the south bank of Antipoison Creek lying upstream of a line drawn from latitude/longitude map coordinate (37°37'45.2", -76°20'36.0") to map coordinate (37°37'46.3", -76°20'31.7").

Recommended by:

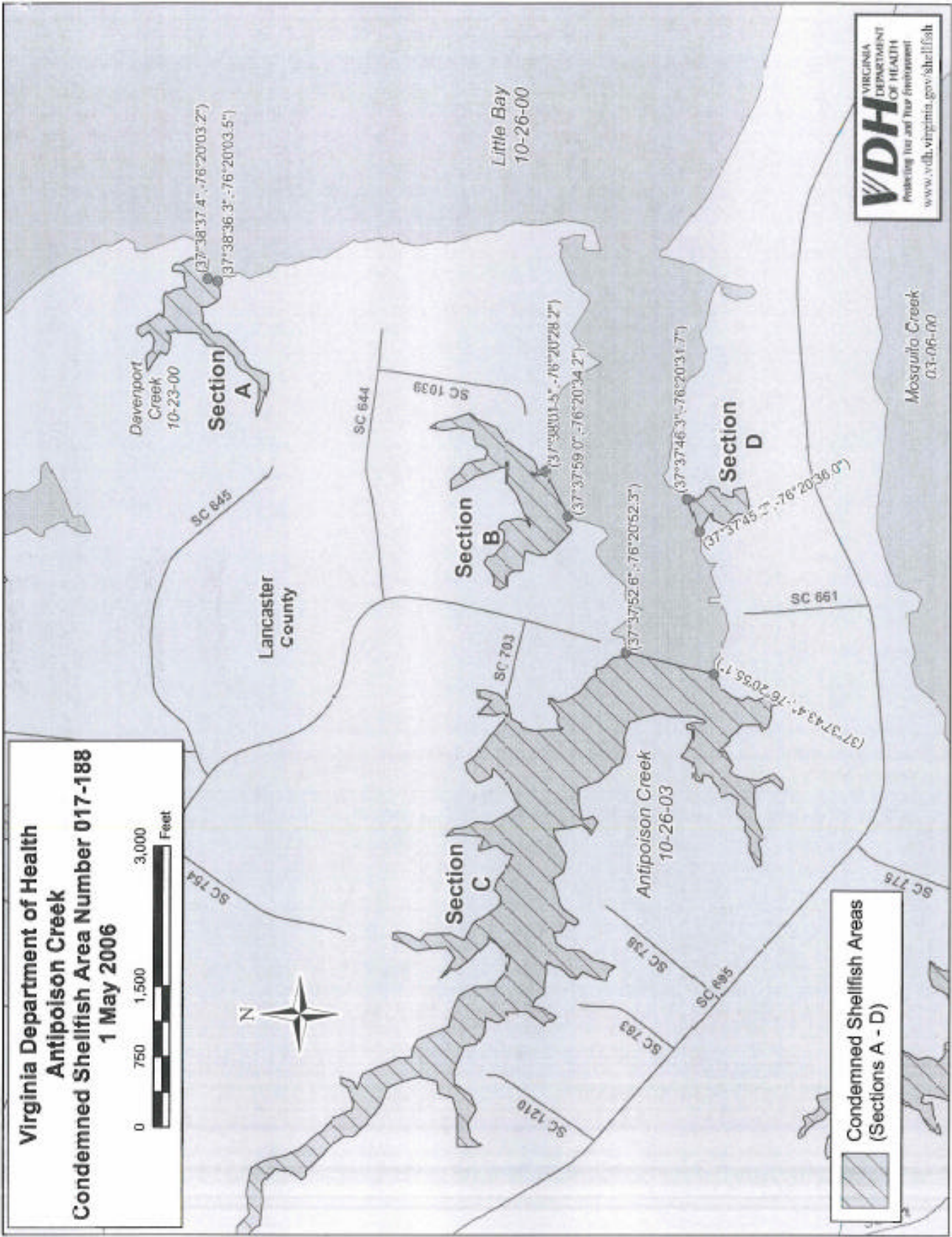
  
Director, Division of Shellfish Sanitation

Ordered by:

  
State Health Commissioner

4/17/06  
Date







## **COMMONWEALTH of VIRGINIA**

### **Department of Health DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487  
Fax: 804-864-7481

#### **INDIAN, DYMER AND TABBS CREEKS Growing Area # 016 Lancaster and Northumberland Counties Shoreline Sanitary Survey**

Date: 21 January 2004 – **REVISED 29 January 2004**  
Survey Period: October 18, 2002 - October 31, 2003  
Total Number of Properties Surveyed: 1,099  
Surveyed By: R.M. Thomas, D.B. Geeson, and R.S. Morris

#### **SECTION A: GENERAL**

This survey area extends from Reference Point 16 at Bluff Point to Reference Point 17 at the first point south of the mouth of Tabbs Creek, including Barnes Creek, Henrys Creek, Indian Creek (Bells Creek, Arthur Cove, Waverly Cove, Pitmans Cove, and Long Creek), Dyer Creek (Rones Bay, Lees Cove, Hunts Cove, Johnson Cove, Duntons Millpond, Chases Cove, Apple Grove Cove, Georges Cove, and Ashley Cove), Tabbs Creek and all of their tributaries.

The topography in this area varies from 5' or less along the shoreline to a maximum of 100' at the western edges of the survey boundary.

The economy of the area is dependent primarily on agriculture, seafood, and commerce. Population is sparse to moderate in the area with the largest concentrations in the Town of Kilmarnock. All properties surveyed are served by individual on-site sewage disposal facilities. The Town of Kilmarnock is served by a sewerage system connected to a sewage treatment plant (prop. # 5). One septic tank cleaning dumpsite (prop. # 15) is located in the area.

Meteorological data indicated that 81.89" of rain fell during the survey period. A monthly breakdown follows:

October 18-31, 2002	3.35"	March	5.22"	July	7.68"
November	6.45"	April	5.22"	August	7.12"
December	4.52"	May	11.25"	September	11.08"
January, 2003	6.18"	June	4.74"	October	2.52"
February	6.56"				

Since the last survey was completed in October 1994, the number of animal pollution sources has decreased from 4 to 3. One of the sites contributes pollution directly to Tabbs Creek. Sites that produce industrial waste have decreased from 4 to 2. In this category, Rappahannock Seafood Company has gone out of business and Hurst Harvey Oil Company was bought out by Noblett Oil and Propane Company (properties adjacent to each other) which was listed on the previous survey.



Information in this report is gathered by and primarily for use of the Division of Shellfish Sanitation, Virginia State Department of Health, in order to fulfill its responsibilities of shellfish growing area supervision and classification. However, the data are made available to various agencies participating in shellfish program coordinated activities or other interested parties.

This report lists only those properties that have a sanitary deficiency or other environmental significance. "DIRECT" indicates that the significant activity or deficiency has a direct impact on shellfish waters. Individual field forms with full information on properties listed in this report are on file in the Richmond Office of the Division of Shellfish Sanitation and available for reference until superseded by a subsequent survey of the area.

Report copies are provided to the local health department for corrective action of deficiencies listed on the summary page in Section B.2 and the Department of Environmental Quality, Water Regional Office for possible action at the properties listed on the summary page in sections C.1 and C.2. The Division of Soil and Water Conservation is provided information on possible sources of animal pollution found in Section E.

Copies of Bacteriological, Hydrographic and Shellfish Closure data are available at the area office for review. Copies of the current condemnation notices and maps are available via the Internet at <http://www.vdh.virginia.gov/oehs/shellfish/>.

## SECTION B: SEWAGE POLLUTION SOURCES

### SEWAGE TREATMENT FACILITIES

5. **DIRECT** - Town of Kilmarnock, P.O. Box 1357, Kilmarnock, 22482. Public-sewage treatment facility. 4 Employees. 841 Connections. This facility is designed for a flow of 0.500 MGD and consists of a comminutor, bar screen, duplicate flow equalization basins, 2 reactor clarifiers, 2 traveling bridge filters with ultra-violet disinfection, and a weir box. Final effluent is discharged to a tributary of Indian Creek. Has VPDES permit # VA0020788 from Dept. of Environmental Quality. For further information, see engineering study attached to the back of this report.
15. Occupant: Essential Systems, Inc., Route 3, Kilmarnock 22482. Owner: Charles Chase Enterprises, Inc., P.O. Box 217, Kilmarnock 22482. Public-sewage disposal site. No contact. Operation consists of two bermed lagoons approximately 200'x125'x10'; one lagoon is empty and grown up with grass and the other one has been filled to approximately 4' remaining freeboard. The grass surrounding the lagoons has been recently cut.

### ON-SITE SEWAGE DEFICIENCIES

1. CONTRIBUTES POLLUTION (Kitchen or Laundry Waste): Occupant: 2517 Bluff Point Road, Kilmarnock, 22482. Owner: 2517 Bluff Point Road, Kilmarnock, 22482. Dwelling - Olive and white Aluminum siding 1 story. Cracked lid on grease trap cover ~100' from ditch at 10' elevation. Sanitary notice issued 11/25/03 to field # A-42.
9. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) - Location: P.O. Box 1394, Kilmarnock, Va. 22482. Dwelling- White particle board 1-story. 1½" white PVC pipe draining contents of kitchen sink and washing machine onto ground surface approximately 300' from the headwaters of Pitman's Cove at 0' elevation. Sanitary Notice issued 3-28-03 to field # B78.

10. CONTRIBUTES POLLUTION - Location: 49 Fleet's Bay Road, Kilmarnock, Va. 22482. Dwelling- Gray frame 1-story with white trim. 5 persons. Unusable privy located approximately 350' from the headwaters of Pitman's Cove at 20' elevation. Sanitary Notice issued 4-11-03 to field # B76.
16. CONTRIBUTES POLLUTION, *DIRECT* - Location: 17430 Mary Ball Road, White Stone 22578. Dwelling- blue vinyl siding 1 story with white shutters. 1 person. Effluent erupting from uncovered septic tank onto ground surface at 20' elevation 50' from Dymer Creek headwater. Sanitary Notice issued 8-8-03 to field # 351.
17. CONTRIBUTES POLLUTION, *DIRECT* - Location: (Crosby's Chicken), 17592 Mary Ball Road, White Stone 22578. Business - white cement block restaurant. 1 person. Effluent erupting from septic tank directly into Dymer Creek headwater. Sanitary Notice issued 8-3-03 to field # 349.
18. CONTRIBUTES POLLUTION: Location: 39 Chase's Road, White Stone, 22578. Owner: 1631 Laurens Street, Baltimore, MD 21217. Dwelling - Cream Aluminum siding 1 story with red shutters. 4 persons. Effluent erupting to ground surface from septic tank 75' from ditch at 20' elevation. Sanitary notice issued 6-20-03 to field # C-107.
20. CONTRIBUTES POLLUTION - Location: 1403 Ocran Road, White Stone 22578. Dwelling - gray and white house trailer. 1 Person. Septic tank has 1 broken lid and one that does not fit properly. Pipe from the house to the septic tank is clogged. Sanitary Notice issued 6-13-03 to field # 250.
24. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) *DIRECT*- Location: 4340 Angus Road, Richmond 23234. Dwelling - gray "Travelite" house trailer with heat stack. No contact. 2" galvanized pipe from kitchen sink drain exits back of trailer at zero elevation 150' from salt marsh connecting Tabbs Creek. Sanitary Notice issued 9-29-03 to field # 168.
25. CONTRIBUTES POLLUTION, *DIRECT* - Location: 1491 Little Bay Road, White Stone 22578. Dwelling - white wood siding 2 story with gray shutters. 1 person. Effluent erupting onto ground surface from septic tank 70' from Tabbs Creek at 8' elevation. Sanitary Notice issued 10-25-02 to field # 70.
26. CONTRIBUTES POLLUTION - Location: 1437 Locust Grove Road, Topping 23169. Dwelling - Renovated former country store. Unpermitted septic system consisting of 2 above-ground polypropylene tanks connected to household drains - 1 tank being used for storage of toilet wastes. Sanitary Notice issued 2-7-03 to field # 1A.

#### NO FACILITIES

26. NO FACILITIES - Location: 1437 Locust Grove Road, Topping 23169. Dwelling - Renovated former country store. Vault privy is unused and locked. Sanitary Notice issued 2-7-03 to field # 1A.

#### POTENTIAL POLLUTION

3. Indian Creek Yacht and Country Club, P.O. Box 1508, Kilmarnock 22482. Private yacht and country club. 50 employees. Manager stated that there had been drainfield failures in the past, but that they were currently working with Whay's septic service, an engineer, and Northumberland County local health to correct the problems. Drainfields appear to be in satisfactory condition at time of survey.

## SECTION C: NON-SEWAGE WASTE SITES

### INDUSTRIAL WASTES

8. Noble Oil & Propane Company, P.O. Box 426, Waverly Avenue, Kilmarnock, Va. 22482. Business- oil storage and distribution facility. 5 Employees. Oil & gasoline is stored in three 20,000 gallon tanks and then distributed via trucks. A new 3' concrete containment wall (berm) surrounds the storage tanks and is located along the bank of Indian Creek. A 1000-gallon diesel tank is located without a berm behind the office.
21. Winegar's Marine Railroad and Dymmer Creek Seafood (Catherine Davenport), 1005 Poplar Neck Road, White Stone 22578. Business - Marine railway and finfish/soft crab processing operation. 3 employees. Observed on-site was 1x1000-gallon diesel fuel tank without a berm 40' from George's Cove. Washdown wastes from seafood processing operation drains into George's Cove. Has VPDES permit #VA0071595 from the Department of Environmental Quality.
22. Location: 555 Ocran Road, White Stone 22578. Pasture. No contact. Observed on-site was 1x500-gallon diesel fuel tank without a berm at 5' elevation 25' from George's Cove off Dividing Creek.

### SOLID WASTE DUMPSITES

-None-

## SECTION D: BOATING ACTIVITY

### MARINAS

7. Chesapeake Boat Basin Inc., 1686 Waverly Ave. Kilmarnock, 22482. Owner: Clay Holcomb. Commercial Marina. 3 employees. 49 slips; 50 dry storage spaces. Present at time of survey were 31 pleasure boats under 26'; 8 pleasure boats 26'-39'. In dry storage were 42 pleasure boats under 26' and 9 boats 26'-39' were in dry storage. Boating services provided are fuel, water, electricity, and an in-out ramp. There are 1000 and 2000-gallon gasoline above-ground storage tanks located approximately 50' from high tide mark at 5' elevation. There is no berm around the tank. Sanitary facilities provided are 2 flush toilets and 2 lavatories for men; and 3 flush toilets and 2 lavatories for women. Sewage disposal is by septic tank with drainfield located 175' from high tide mark at 5' elevation, which appeared to be working satisfactorily at time of inspection. A sewage holding tank pumpout facility is located on site with year round services.
21. Winegar's Marine Railway (Catherine Davenport), 1005 Poplar Neck Road, White Stone 22578. Marine railway and fish processing plant. 3 employees. 8 slips/moorings2 /dry storage spaces available. Present at time of survey were 1 pleasure boat and 4 work boats under 26' and 1 pleasure boat and 3 work boats over 26' in wet slips; and in dry storage there was 1 work boat under 26'. Boating services provided were fuel (for owner's vessel only), water, electricity and repair. Containers are available for solid waste collection. Sanitary facility provided is 1 unisex portable toilet and is serviced monthly by Essential Systems. This toilet is also used as a portable toilet dump station facility. There is no holding tank pump-out facility provided.



23. Ocran Boat Shop, 1935 Ocran Road, White Stone 22578. Owner: F.H. Ajootian, P.O. Box 783, White Stone. Commercial marina. 2 employees. 7 slips/moorings/2 dry storage spaces available. Present at the time of survey were 1 pleasure boat under 26' and 6 pleasure boats over 26' in wet storage; and in dry storage there were 2 pleasure boats under 26'. Boating services provided are fuel, water, electricity and repair. Containers are available for solid waste collection. Sanitary facilities provided are 1 commode and 1 lavatory for men. Sewage disposal is by septic tank and drainfield, which appeared to be in satisfactory condition at time of inspection. Portable toilet dump station facilities and boat holding tank pump-out facilities are not provided at this location.

#### OTHER PLACES WHERE BOATS ARE MOORED

2. Mike Croxton Seafood, Inc. Owner: Mike Croxton, Rt.1, Box 490, Kilmarnock 22482. Business-crab shedding facility and private pier for docking certified dam boat (VA521-SS). 3 moorings. Present at time of survey were 2 work boats >26'. Boating services provided are fuel, water, and electricity at slips. Sanitary facilities are available at owner's home, which is within walking distance. Sewage disposal is by septic tank with drainfield, which appeared to be in satisfactory condition, located approximately 275' from Henry's Creek at 7' elevation. There are no boat holding tank pump-out facilities provided at this location.
4. Indian Creek Yacht and Country Club, P.O. Box 1508, Kilmarnock 22482. Private yacht club. 50 employees. 20 slips/2 moorings; 3 dry storage spaces. Present at time of survey were 5 pleasure boats under 26', and 1 pleasure boat 26'-39'. Boating services provided are water and electricity at slips. Sanitary facilities provided are 1 flush toilet, 1 urinal, 1 lavatory, and 1 shower for men; and 1 flush toilet, 1lavatory, and 1shower for women. Sewage disposal is by septic tank with drainfield, which appeared to be in satisfactory condition, located ~15'from Indian Creek at 7' elevation. Boat holding tank pump-out facilities consist of a manual pump, with a 55-gallon storage tank serviced by Essential Systems of Kilmarnock. Pump-out is available upon request.
6. Perdue Farms, 1671 Waverly Ave. Kilmarnock, Va. 22482. Manager: M. Heath Bray. Business – grain elevator on Waverly Ave. 2 employees. 3 moorings. There were 3-grain barges & 1 tugboat present at time of survey. Boating services provided are water & electricity on dock. Sanitary facilities provided are 1 flush toilet and 1 lavatory for men. Sewage disposal is by septic tank with drainfield, which appeared to be in satisfactory condition, located approximately 100' from Indian Creek at 12' elevation. There are no boat holding tank pump-out facilities provided at this location.
12. R&R Unlimited, Inc., White Stone, 22578. Owner: W.L. Blankenbaker, President. 2350 Suffolk Road, Charlottesville, 22901. Community Pier. No Contact. 4 slips/5 moorings. Present at time of survey were 3 pleasure boats under 26'. Boating services provided are water and electricity at slips. Has an exemption to the requirements to provide boat holding tank pump-out facilities and sanitary facilities.
13. Blue Water Point Estates. Owner: Blue Water Point Homeowners Association, P.O. Box 1687, Kilmarnock 22482. Community Pier. No contact. 10 slips/moorings. Present at time of survey were 7 pleasure boats under 26' at the pier. There are no boating services provided at this location. Has exemptions to the requirements to provide boat holding tank pump-out facilities and sanitary facilities.

**UNDER SURVEILLANCE**

19. Dymer Shores Property Owner's Association, Rt.1, Box 655, White Stone 22578. Private boat launching facility. No contact. 4 moorings. There were no boats present at time of survey. The only boating service provided is an in-out ramp. There are no sanitary facilities and no boat holding tank pump-out facilities provided at this location.

**SECTION E: CONTRIBUTES ANIMAL POLLUTION**

11. Location: 489 Fleet's Bay Road, Kilmarnock 22482. Dwelling – white frame 2-story with black shutters. 4 persons. Present at time of survey were 2 cows, 4 goats, 9 chickens and 2 guineas. These animals were in a fenced area with a small shed/stable, with manure left in pasture approximately 350' from Pitman's Cove.
14. George E. and Michelle L. Simmons, 527 Simmons Lane, White Stone, 22578. Pasture. Present at time of survey were 5 horses in fenced pasture. Manure is left on ground approximately 5' from ditch at 20' elevation.
25. **DIRECT** - Location: 1491 Little Bay Road, White Stone 22578. Dwelling - white wood siding 2 story with gray shutters. 1 person. Present at time of survey were 14 cows in a fenced pasture with direct access to Tabbs Creek. There were 8 horses in a fenced in stable compound approximately 200 yards from Tabbs Creek. Manure is left on the ground.

Shoreline Survey # 016  
Page 7

## SUMMARY

Area # 016  
Indian, Dymmer, and Tabbs Creeks  
21 January 2004 – *REVISED 29 January 2004*

### SECTION B: SEWAGE POLLUTION SOURCES

#### 1. SEWAGE TREATMENT WORKS

- 1 – DIRECT – # 5
- 1 – INDIRECT – # 15
- 2 – B.1. TOTAL

2. ON-SITE SEWAGE DEFICIENCIES – Correction of deficiencies in this section is the responsibility of the local health department.

- 3 – CONTRIBUTES POLLUTION, DIRECT – # 16, 17, 25
- 4 – CONTRIBUTES POLLUTION, INDIRECT – # 10, 18, 20, 26
- 1 – CP (Kitchen or Laundry Wastes), DIRECT – # 24
- 2 – CP (Kitchen or Laundry Wastes), INDIRECT – # 1, 9
- 0 – NO FACILITIES, DIRECT – None
- 1 – NO FACILITIES, INDIRECT – # 26
- 11 – B.2. TOTAL

3. POTENTIAL POLLUTION – Periodic surveillance of these properties will be maintained to determine any status change.

- 1 – POTENTIAL POLLUTION – # 3

### SECTION C: NON-SEWAGE WASTE SITES

#### 1. INDUSTRIAL WASTE SITES

- 0 – DIRECT – None
- 3 – INDIRECT – # 8, 21, 22
- 3 – C.1. TOTAL

#### 2. SOLID WASTE SITES

- 0 – DIRECT – None
- 0 – INDIRECT – None
- 0 – C.2. TOTAL

### SECTION D: BOATING ACTIVITY

- 3 – MARINAS – # 7, 21, 23
- 5 – OTHER PLACES WHERE BOATS ARE MOORED – # 2, 4, 6, 12, 13,
- 1 – UNDER SURVEILLANCE – # 19
- 9 – D. TOTAL

### SECTION E: CONTRIBUTES ANIMAL POLLUTION

- 1 – DIRECT – # 25
- 2 – INDIRECT – # 11, 14
- 3 – E. TOTAL

**INDIAN, DYMER, AND TABBS CREEK**  
Lancaster and Northumberland Counties

**Engineering Study**

Date: 13 June 2003

By: R.S. Morris

This report is provided to supplement the current shoreline sanitary survey with information on facilities of sanitary engineering importance. It is necessary to include data on sewage treatment plants due to the large populations or volumes of waste these installations treat that cause them to significantly impact water quality. The effect of discharges, sewage bypasses, or equipment malfunctions are definite public health hazards and vital factors in proper evaluation of the area classification. Included is a brief description of these facilities.

Town of Kilmarnock Sewage Treatment Facility

Present during inspection was Keith Robertson, chief operator of the Kilmarnock Sewage Treatment facility, Richard Morris, Division of Shellfish Sanitation.

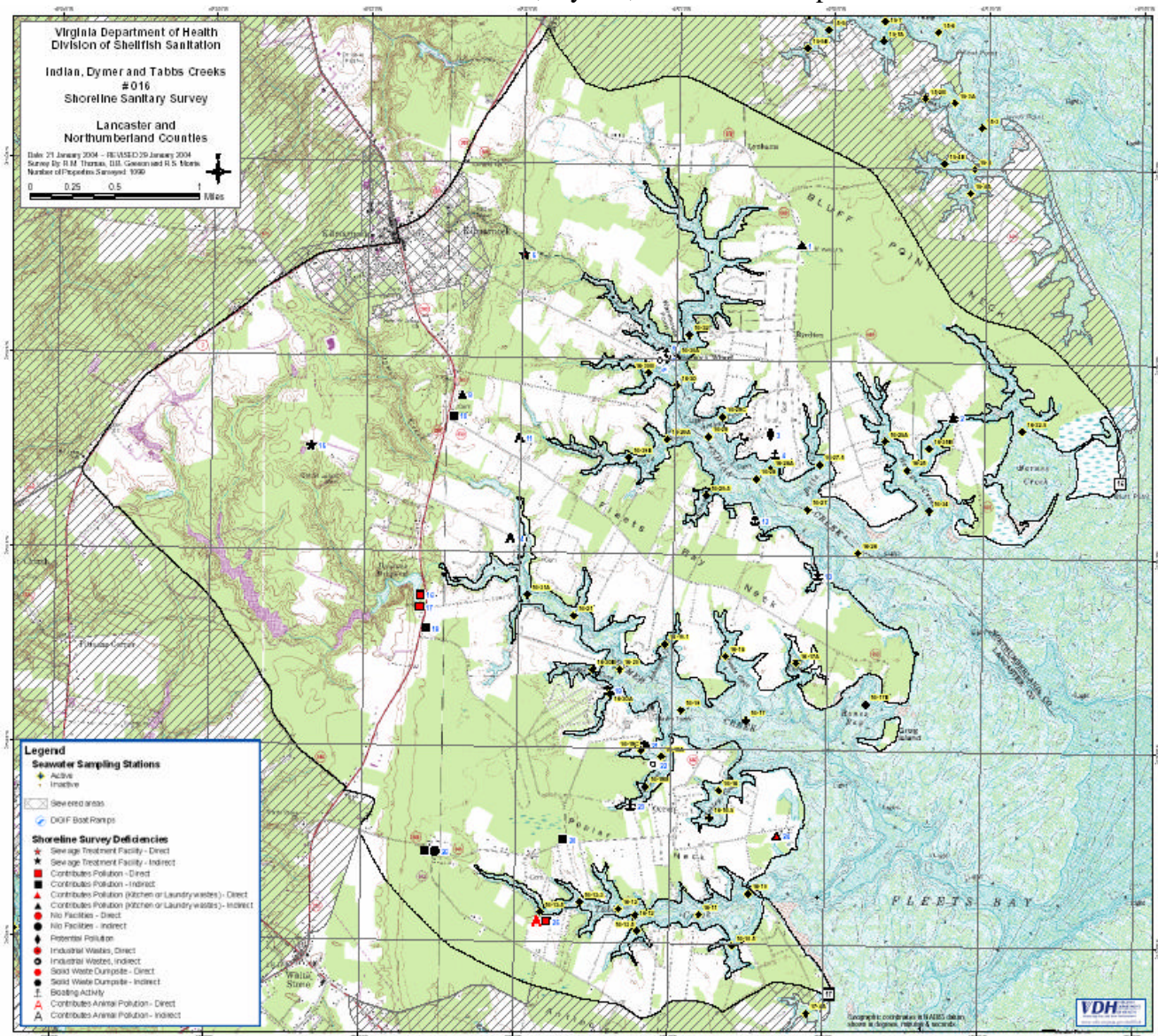
Treatment facilities consist of a Helisieve with a bar screen on an alternate flow channel, duplicated flow equalization basins, 2 reactor clarifiers, 2 traveling bridge filters, U.V. disinfection, a weir box with 90 degree V-notch for flow measurement, and an air diffuser for post aeration.

The treatment plant serves a population of approximately 1244 with 841 connections and operates under VPDES permit #0020788 from DEQ. Permit effluent limits are for a flow of 0.500 MGD. , suspended solids of 16 mg/l, 200 geometric mean for fecal bacteria, and 6.5 mg/l dissolved oxygen. Effluent is discharged into a tributary of Indian Creek. Sludge is removed by Recyc Systems Inc. for land application.

Flow measurement is by ISCO Ultrasonic meter with totalizer and chart recorder.

Raw sewage is transported to the plant by gravity and four pump stations, of which only one is located on this area watershed.

# Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL







**COMMONWEALTH of VIRGINIA**

**Department of Health  
DIVISION OF SHELLFISH SANITATION**

109 Governor Street, Room 614-B  
Richmond, VA 23219

Ph: 804-864-7487

Fax: 804-864-7481

**LITTLE BAY AND ANTIPOISON CREEK**

**Shoreline Survey # 017**

**Lancaster County**

**Shoreline Sanitary Survey**

**Date:** 6 July 2001

**Survey Period:** March 19 – May 31, 2001

**Total Number of Properties Surveyed:** 308

**Surveyed By:** D.B. Geeson and R.M. Thomas

**SECTION A: GENERAL**

This survey area extends from Reference Point 17 at the first point south of Tabbs Creek to Reference Point 18 at North Point, including the Fleets Bay shoreline between these two points, Little Bay [Antipoison Creek (Harpers Creek)], and all of their tributaries. The survey boundary has been revised. See map for current boundary.

The topography in this area varies in elevation from 5' or less along the shoreline to a maximum of 20' near the western edge of the survey boundary. The economy is based primarily on agriculture, commercial fishing, recreation and service oriented businesses. The population density is moderate with the heaviest concentrations in eastern White Stone, the communities of Palmer and Foxwells and along the shoreline. Most of the properties along the shoreline are vacation homes and are only seasonally occupied.

The current restriction on shellfish harvesting in this area is Condemned Shellfish Area #017-188, Antipoison Creek, effective 19 May 2000. Copies of the current condemnation notices and maps are available via the Internet at <http://www.vdh.virginia.gov/oehs/shellfish/>.

Meteorological data indicated that 2.94" of rain fell March 19-31, 3.63" April 1-30, and 7.38" May 1-31, for a total of 13.95" for the survey period.

There was one campground (Camp Little Bay) in the area and it was found to be in satisfactory condition at time of inspection. Julia's Seafood, which was mentioned in the previous report as an industrial waste facility, is now known as Captain Georges Seafood and is trading as Little Bay Lookout.

Information in this report is gathered by and primarily for the use of the Division of Shellfish Sanitation, Virginia Department of Health, in order to fulfill its responsibilities of shellfish growing area supervision and classification. However, the data is made available to various agencies participating in shellfish program coordinated activities and other interested parties.

Report copies are provided to the local health department for corrective action of deficiencies listed on the summary page in Section B.2 and the Department of Environmental Quality (DEQ) for possible action at the properties listed on the summary page in Section C.1. The Division of Soil and Water Conservation is provided information on possible sources of animal pollution found in Section E.

This report lists only those properties that have a sanitary deficiency or other environmental significance. "***DIRECT***" indicates that the significant activity or deficiency has a direct impact on shellfish waters. Individual field forms with full information on properties listed in this report are on file in the Richmond office of the Division of Shellfish Sanitation and are available for reference until superseded by a subsequent resurvey of the area.

## SECTION B: SEWAGE POLLUTION SOURCES

### SEWAGE TREATMENT WORKS

-None-

### ONSITE SEWAGE DEFICIENCIES

1. CONTRIBUTES POLLUTION, ***DIRECT*** - Location: 361 Tammy Drive, White Stone 22578. Owner: Bank of Lancaster, Trustee for Howard H. Barrack Estate, P. O. Box 1869, Kilmamock 22482. Dwelling- red frame 1 story with white trim. No contact. Unapproved plywood lid over septic tank. Effluent erupting from septic tank and drainfield onto ground surface 35' from Little Bay. Sanitary Notice issued 3-23-01 to field # A15.
6. CONTRIBUTES POLLUTION - Location: 2182 Little Bay Road, White Stone 22578. Dwelling- white vinyl siding 1 story with black trim. 1 person. Broken lid over distribution box. Effluent erupting onto ground surface. Sanitary Notice issued 4-27-01 to field # A97.
8. CONTRIBUTES POLLUTION - Location: 1805 Windmill Point Road, White Stone 22578. Owner: 340 North Madison Street, Marshall, MI 49068. Dwelling- frame 2 story with white asbestos shingles. 3 persons. Effluent erupting from septic tank and drainfield onto ground surface. Sanitary Notice issued 5-1-01 to field # B82.
11. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) - Location: 2360 Windmill Point Road, White Stone 22578. Owner: 4711 King William Road, Richmond 23225. Dwelling- white frame 2 story. No contact. Kitchen wastes discharge through a 1½" PVC pipe into a cracked grease trap without a cover. Sanitary Notice issued 5-11-01 to field # B58.
13. NO FACILITIES, ***DIRECT*** - Occupant: Little Bay Fish Company, 200 Osprey Lane, White Stone 22578. Owners: Glen and June Steel, Box 7985, White Stone. Private pier. 1 person. Sanitary Notice issued 7-5-01 to field # B50.
14. CONTRIBUTES POLLUTION - Occupant: Tanya Kelly, 3465 Windmill Point Road, White Stone 22578. Owner: 905 Spotswood Road, Richmond 23200. Dwelling- brown and white house trailer. 2 persons. Effluent erupting from drainfield onto ground surface. Sanitary Notice issued 4-27-01 to field # B43.

15. CONTRIBUTES POLLUTION - Location: 3806 Windmill Point Road, White Stone 22578. Dwelling- aqua and white house trailer. 2 persons. Effluent erupting from septic tank onto ground surface. Sanitary Notice issued 4-24-01 to field #B32.
16. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes), **DIRECT** – Location: 4621 Windmill Point Road, White Stone 22578. Owners: 7908 Beverly Road, Baltimore, MD 21234. Dwelling- beige vinyl siding 2 story. No contact. Kitchen or laundry wastes discharge from underneath dwelling through a 1½" PVC pipe into a 4" PVC pipe onto ground surface 75' from Little Bay. Sanitary Notice issued 4-24-01 to field #B12.

#### POTENTIAL POLLUTION

-None-

### SECTION C: NON-SEWAGE POLLUTION SOURCES

#### INDUSTRIAL WASTES

4. Menhaden Bait Company, Incorporated (Roland George), 1675 Little Bay Road, White Stone 22578. Business- fish processing facility. 2 employees. Observed onsite was 1 X 1000 gallon diesel fuel tank 5' from Antipoin Creek surrounded by a 3' concrete berm.
5. **DIRECT** - Occupant: Pride of Virginia Seafood, 3121 Little Bay Road, White Stone 22578. Owner: C. W. O'Bier, Route 1, Box 37C, Callao 22435. Business- commercial shellfish processing plant (VA-1034SP). 20 employees. Processing wastes and floor drains discharge into a settling tank and the overflow drains into Antipoin Creek. Has Permit # VAG524039 from DEQ. Permit expires 7-24-01.
7. Occupant: Cully's Railway, 312 Harpers Creek Drive, White Stone 22578. Owner: Edward L. Cullingsworth, 3504 Nine Mile Road, Richmond 23223. Business- commercial marina. 1 employee. Observed onsite was 1 X 500 gallon diesel fuel tank 5' from Harpers Creek without a protective berm.
10. **DIRECT**- Chesapeake Bay Fish and Oyster (Marvin George), 213 Fox Den Road, White Stone 22578. Business has not been in operation for several years. 2 persons. Processing wastes and floor drains would discharge into Harpers Creek if plant was active. Has Permit # VAG524016 from DEQ. Permit expires 7-24-2001.
13. Occupant: Little Bay Fish Company, 200 Osprey Lane, White Stone 22578. Owners: Glen and June Steel, Box 7985, White Stone. Business is no longer in operation. 1 person. Observed onsite was 1 x 500 gallon diesel fuel tank 40' from Antipoin Creek without a protective berm.
17. **DIRECT** - Occupant: Captain Georges Seafood (Little Bay Lookout), 4771 Windmill Point Road, White Stone 22578. Owners: Billy and Barbara Ancarrow, 703 Baywater Drive, Kilmarnock 22482. 1 person. New owners have an active permit from DEQ, but at this time they are unsure about what they plan to do with the business. Processing wastes and floor drains would discharge into Little Bay if plant was active. Has Permit # VAG524027 from DEQ. Permit expires 7-24-2001.

**SOLID WASTE DUMPSITES**

-None-

**SECTION D: BOATING ACTIVITY**

**MARINAS**

7. Cully's Railway, 312 Harpers Creek Drive, White Stone 22578. Owner: Edward L. Cullingsworth, 3504 Nine Mile Road, Richmond 23223. Commercial marina. 1 employee. 14 slips/moorings available. Present at time of survey was 1 pleasure boat and 1 work boat under 26' and 2 work boats and 3 pleasure boats over 26'. Boating services provided are electricity, repair and water. Containers are available for solid waste. Sanitary facilities provided are 1 vault privy for men and 1 vault privy for women, which appeared to be in satisfactory condition at time of inspection. Sewage disposal is by pump and haul. Privies are used as a portable toilet dump station facility. Boat holding tank pump-out facilities are provided at this location, but were inoperable at time of inspection.
13. Little Bay Fish Company, 200 Osprey Lane, White Stone 22578. Owners: Glen and June Steel, Box 7985, White Stone. Private boat docking facility. 1 person. 3 slips/moorings available. Present at time of survey was 1 work boat under 26' and 1 work boat over 26'. Boating services provided are electricity and water. Containers are available for solid waste. There are no sanitary facilities or portable toilet dump station facilities provided. Owner has an exemption to the requirement to provide boat holding tank pump-out facilities at this location.

**OTHER PLACES WHERE BOATS ARE MOORED**

2. Charles Marchetti Pier, 1028 Clarks Point Road, White Stone 22578. Private boat docking facility. 3 persons. 16 slips/moorings available. Present at time of survey were 3 pleasure boats under 26' and 2 pleasure boats over 26'. Boating services provided are water, electricity and an in-out ramp. Containers are provided for solid waste. Sanitary facilities are available in the main house and the pool houses. Sewage disposal is to a septic tank with drainfield, which appeared to be in satisfactory condition at the time of inspection. There are no boat holding tank pump-out facilities or portable toilet dump station facilities available at this location.
9. Bay Seafood and Bay Company, 1883 Windmill Point Road, White Stone 22578. Owner: Meridith Robbins, 1253 Cherry Point Road, White Stone. Private boat docking facility. 2 employees. 7 slips/moorings available. Present at time of survey were 3 pleasure boats under 26' and 2 work boats and 1 pleasure boat over 26' in wet slips; and in dry storage there were 4 work boats and 8 pleasure boats under 26' and 1 work boat over 26'. Boating services provided are electricity, in-out ramp and water. Containers are provided for solid waste. The only sanitary facilities available are 1 pit privy, which appeared to be in satisfactory condition at time of inspection. Privy is used as a portable toilet dump station facility. Owner has an exemption to the requirement to provide boat holding tank pump-out facilities at this location.

**UNDER SURVEILLANCE**

12. Nova Bait Company (David George), 202 Antirap Drive, White Stone 22578. Business: menhaden bait company. 2 slips/moorings available. Present at time of survey were 3 work boats under 26' and 2 work boats over 26' in wet slips; and in dry storage there was 1 pleasure boat under 26'. The only boating service provided is electricity. There are containers provided for solid waste. Sanitary facilities provided are 4 commodes, 4 lavatories, and 1 shower for men; and 4 commodes, 4 lavatories, and 1 shower for women. There is also 1 unisex toilet available. Sewage disposal is by pump and haul and by a septic tank with drainfield, which appeared to be in satisfactory condition at time of inspection. There are no portable toilet dump station facilities or boat holding tank pump-out facilities provided at this location.

**SECTION E: CONTRIBUTES ANIMAL POLLUTION**

3. Limerick Morgan Horse Farm, Clarks Point Road, White Stone 22578. Owner: Richard W. O'Brien, P. O. Box 698, White Stone. Dwelling- white frame 2½ story with black trim. 3 persons. Present at time of survey were 5 horses in a fenced pasture 200' from Antipoison Creek. Manure is left on the ground.



Shoreline Survey # 017  
Page 6

## SUMMARY

Area # 017  
Little Bay and Antipoison Creek  
6 July 2001

### SECTION B: SEWAGE POLLUTION SOURCES

#### 1. SEWAGE TREATMENT WORKS

- 0 - DIRECT - None
- 0 - INDIRECT - None
- 0 - B.1. TOTAL

#### 2. ON-SITE SEWAGE DEFICIENCIES

- 1 - CONTRIBUTES POLLUTION, DIRECT - # 1
- 4 - CONTRIBUTES POLLUTION, INDIRECT - # 6, 8, 14, 15
- 1 - CP (Kitchen or Laundry Wastes), DIRECT - # 16
- 1 - CP (Kitchen or Laundry Wastes), INDIRECT, # 11
- 1 - NO FACILITIES, DIRECT - # 13
- 0 - NO FACILITIES, INDIRECT - None
- 8 - B.2. TOTAL

#### 3. POTENTIAL POLLUTION

- 0 - POTENTIAL POLLUTION - None

### SECTION C: NON-SEWAGE WASTE SITES

#### 1. INDUSTRIAL WASTE SITES

- 3 - DIRECT - # 5, 10, 17
- 3 - INDIRECT - # 4, 7, 13
- 6 - C.1. TOTAL

#### 2. SOLID WASTE DUMPSITES

- 0 - DIRECT - None
- 0 - INDIRECT - None
- 0 - C.2. TOTAL

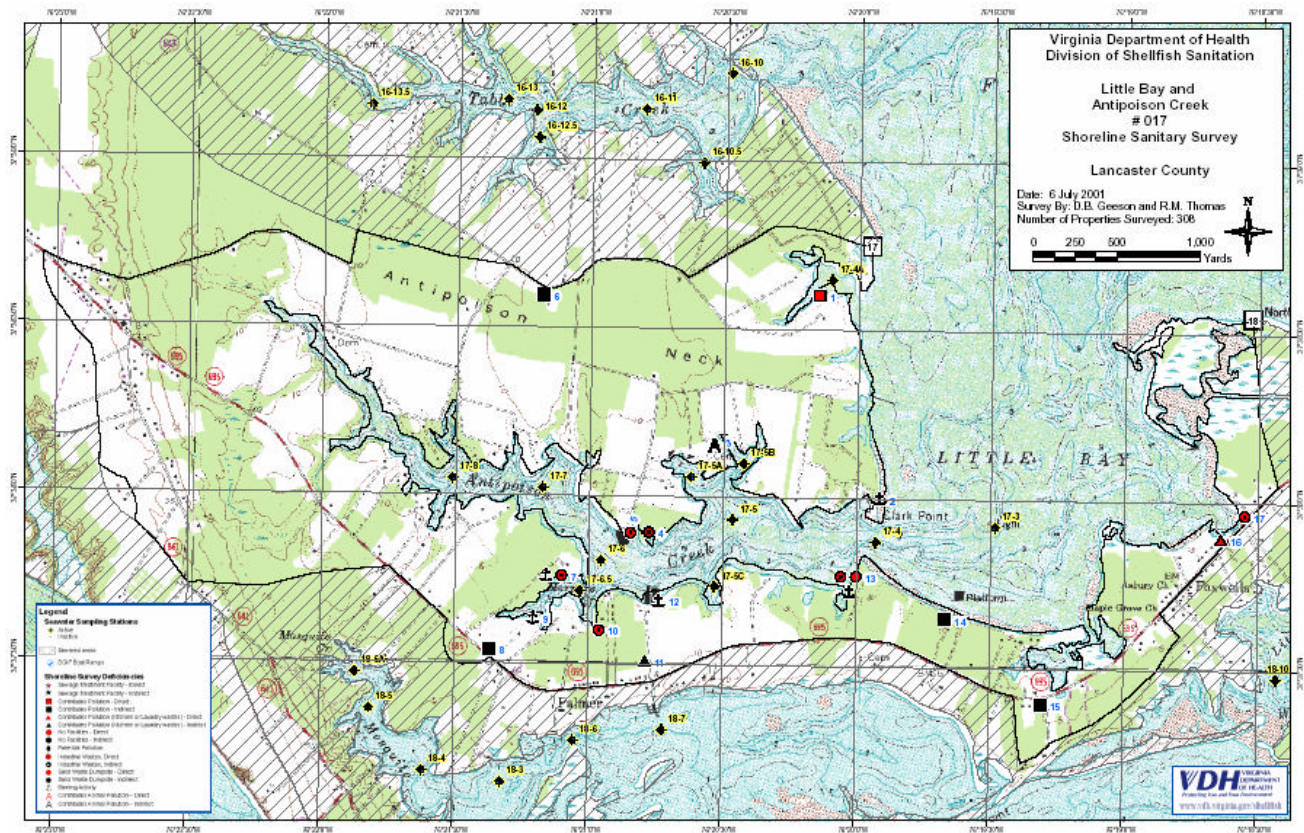
### SECTION D: BOATING ACTIVITY

- 2 - MARINAS - # 7, 13
- 2 - OTHER PLACES WHERE BOATS ARE MOORED - # 2, 9
- 1 - UNDER SURVEILLANCE - # 12
- 5 - D. TOTAL

### SECTION E: CONTRIBUTES ANIMAL POLLUTION

- 0 - DIRECT - None
- 1 - INDIRECT - # 3
- 1 - E. TOTAL

## Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL



## **Appendix B: Supporting Documentation and Watershed Assessment**

- A. Fecal Production Literature Review**
- B. Geographic Information System Data: Sources and Process**
- C. Watershed Source Assessment**

**Table B.1 Fecal Production Literature Review**

	Concentration in feces		Fecal coliform production rate		Comments
	FC/g	Ref.	FC/day (seasonal)	Ref.	
Cat	7.9E+06	1	5.0E+09	4	
Dog	2.3E+07	1	5.0E+09	4	
Chicken	1.3E+06	1	1.9E+08	4	
Chicken			2.4E+08	9	
Cow	2.3E+05	1	1.1E+11	4	average of dairy and beef
Beef cattle			5.4E+09	9	
Deer	1.0E+02	6	2.5E+04	6	assume 250 g/day
Deer	?		5.0E+08	9	best prof. judgment
Duck			4.5E+09	4	average of 3 sources
Duck	3.3E+07	1	1.1E+10	9	
Canada Geese			4.9E+10	4	
Canada Geese	3.6E+04	3	9.0E+06	3	
Canada Geese	1.5E+04	8	3.8E+06	8	assume 250 g/day (3)
Horse			4.2E+08	4	
Pig	3.3E+06	1	5.5E+09	4	
Pig			8.9E+09	9	
Sea Gull	3.7E+08	8	3.7E+09	8	assume 10 g/day
Sea gull			1.9E+09	5	mean of four species
Rabbit	2.0E+01	2	?		
Raccoon	1.0E+09	6	1.0E+11	6	assume 100 g/day
Sheep	1.6E+07	1	1.5E+10	4	
Sheep			1.8E+10	9	
Turkey	2.9E+05	1	1.1E+08	4	
Turkey			1.3E+08	9	
Rodent	1.6E+05	1	?		
Muskrat	3.4E+05	6	3.4E+07	6	
Human	1.3E+07	1	2.0E+09	4	
Septage	4.0E+05	7	1.0E+09	7	assume 70/gal/day/person

1. Geldreich, E. and E. A. Kenner. 1969. Concepts of fecal streptococci in stream pollution. J. Wat. Pollut. Control Fed. 41:R336-R352.

## Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

2. Geldreich, E., E. C. Best, B. A. Kenner, and D. J. Van Donsel. 1968. The bacteriological aspects of stormwater pollution. *J. Wat. Pollut. Control Fed.* 40:1861-1872.
3. Hussong, D., J. M. Damare, R. J. Limpert, W. J. L. Sladen, R. M. Weiner, and R. R. Colwell. 1979. Microbial impact of Canada geese (*Branta canadensis*) and whistling swans.
4. U.S. Environmental Protection Agency. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water (4503F), United States Environmental Protection Agency, Washington, DC. 132 pp.
5. Gould, D. J. and M. R. Fletcher. 1978. Gull droppings and their effects on water quality. *Wat. Res.* 12:665-672.
6. Kator, H. and M. W. Rhodes. 1996. Identification of pollutant sources contributing to degraded sanitary water quality in Taskinas Creek National Estuarine Research Reserve, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 336, The College of William and Mary, VIMS/School of Marine Science.
7. Kator, H., and M. W. Rhodes. 1991. Evaluation of *Bacteroides fragilis* bacteriophage, a candidate human-specific indicator of fecal contamination for shellfish-growing waters. A final report prepared under NOAA Cooperative Agreement NA90AA-H-FD234. Prepared and submitted to NOAA, Southeast Fisheries Science Center, Charleston Laboratory, Charleston, SC. 98 pp.
8. Alderisio, K. A. and N. DeLuca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (*Larus delawarensis*) and Canada geese (*Branta canadensis*). *Appl. Environ. Microbiol.* 65:5628-5630.
9. TMDL report attributed to Metcalf and Eddy 1991 (Potomac Headwaters of West VA).



**Table B.2 GIS Data Elements and Sources**

<b>Type of Information</b>	<b>Data Source</b>	<b>Obtained</b>	<b>Reviewed/ Analyzed</b>
Applicable water quality criteria	<i>Virginia Water Quality Standards</i>	Yes	Yes
Section 303(d) listings	<i>VA DEQ</i>	Yes	Yes
Stream network)	<i>Reach File Version 3 (US EPA BASINS)</i> <i>National Hydrography Data (USGS)</i>	Yes	Yes
Land Use/ Land Cover data	<b><i>National Land Cover Data (NLCD) 1992)</i></b>	Yes	Yes
Soils	<i>County Level Soil SSURGO data 2001</i>	Yes	Yes
Digital Elevation Model (DEM)	<b><i>BASINS / National Elevation Dataset (!0 meter)</i></b>	Yes	Yes
Watershed boundaries	<i>BASINS, VADEQ</i> <i>VIMS Subwatershed Layer</i>	Yes	Yes
Section 303(d) listed segments	<b><i>Virginia Department of Environmental Quality</i></b>	Yes	Yes
County Boundaries	<b><i>BASINS, ESRI</i></b>	Yes	Yes
Roads	<b><i>Virginia Department of Transportation</i></b>	Yes	Yes
Population/ Household/ Septic System Estimates	<b><i>CCRM; VDH-DSS Sanitary Survey</i></b>	Yes	Yes
Wildlife estimates	<i>VIMS ; DGIF</i>	Yes	Yes
Livestock estimates/ agricultural practices	<i>USDA National Agricultural Statistics Service</i> <b><i>Soil and Water Conservation Districts</i></b> <b><i>VA DCR</i></b> <i>VIMS</i>	Yes	Yes
Combined-sewer and stormwater outfall locations	<i>VA DEQ, VA DCR</i> <i>Local agencies</i> <i>VIMS</i>	Yes	Yes
Pet Estimates	<i>CCRM; DGIF</i>	Yes	Yes
Marina Estimates	<i>VIMS , VDH-DSS Sanitary Survey</i>	Yes	Yes
Monitoring data and station locations	<i>VDH DSS</i> <i>Virginia Department of Environmental Quality</i>	Yes	Yes
Meteorological data	<i>National Climatic Data Center (NCDC)</i>	No	No
Tidal Data	<i>National Oceanic and Atmospheric Administration (NOAA)</i> <i>VDH DSS (provided w/ monitoring data)</i>	Yes	Yes
Stream flow data	<i>U.S. Geological Survey</i>	Yes	Yes
Bacteria Source Tracking data (BST)	<i>VDH-DSS, MapTech</i>	Yes	Yes
Permitted facility locations and discharge monitoring reports (DMR)	<i>VA DEQ</i>	Yes	Yes

## **A. GIS Data Description and Process**

Watershed boundary determined by VDH, DSS. There are 105 watersheds in Virginia.

Subwatershed boundaries were delineated based on elevation, using digital 7.5 minute USGS topographic maps. There are 1836 subwatersheds.

The original land use has 15 categories that were combined into 3 categories:  
urban (high and low density residential and commercial);  
undeveloped (forest and wetlands); and  
agriculture (pasture and crops).

Descriptions of Shoreline Sanitary Survey deficiencies are found in each report. Contact DSS for more information. Digital data layer generated by CCRM from hardcopy reports.

Wastewater treatment plant locations were obtained from DEQ and digital data layer was generated by CCRM. Design flow, measured flow, and fecal coliform discharges were obtained from DEQ.

Sewers data layer was digitized from Shoreline Sanitary Surveys by CCRM.

Dog numbers were obtained using the database generated by CCRM. The number of issued dog licenses were supplied by the Treasuries offices of Lancaster and Northumberland Counties. The number of issued licenses was compared to the calculated estimate values based on watershed.

Domestic livestock includes cows, pigs, sheep, chickens, turkeys, and horses. Database was generated by CCRM.

Wildlife includes ducks and geese, deer, and raccoons. Animals were chosen based on availability of fecal coliform production rates and population estimates. Database was generated by CCRM.

Ducks and geese—US FWS, DGIF

Deer—DGIF

Raccoons—DGIF

Human input was based on DSS sanitary survey deficiencies and US Census Bureau population data (number of households).

Water quality monitoring data are collected, on average, once per month. Digital data layer of locations was generated by DSS. Water quality data was mathematically processed and input into a database.

Water bodies were divided into segments based on the location of the monitoring stations (midway between stations). If a segment contained >1 station, the FC values were averaged. If a segment contained 0 stations, the value from the closest station(s) was assigned to it. Digital data layer of segments was generated by CCRM. FC loadings in the water were obtained by multiplying FC concentrations by segment volume.

Segment volume was determined from current field bathymetry data.

The 1998 303d report was used to set the list of condemnation zones that require TMDLs. The digital data layer was generated by CCRM from hardcopy closure reports supplied by DSS.

## **B. Population Numbers**

The process used to generate population numbers used for the nonpoint source contribution analysis for the four source categories: human, livestock, pets and wildlife is described for each below.

### **Human:**

The number of people contributing fecal coliform from failing septic tanks were developed in two ways and then compared to determine a final value.

- 1) Deficiencies (septic failures) from the DSS shoreline surveys were counted for each watershed and multiplied by 3 (average number of people per household).
- 2) Numbers of households in each watershed were determined from US Census Bureau data. The numbers of households were multiplied by 3 (average number of people per household) to get the total number of people and then multiplied by a septic failure rate\* to get number of people contributing fecal coliform from failing septic tanks.

\*The septic failure rate was estimated by dividing the number of deficiencies in the watershed by the total households in the watershed. The average septic failure rate was 12% and this was used as the default unless the DSS data indicated that septic failure was higher.

### **Livestock:**

US Census Bureau data was used to calculate the livestock values. The numbers for each type of livestock (cattle, pigs, sheep, chickens (big and small), and horses) were reported by county. Each type of livestock was assigned to the land use(s) it lives on, or contributes to by the application of manure, as follows:

Cattle	cropland and pastureland
Pigs	cropland
Sheep	pastureland
Chickens	cropland
Horses	pastureland

GIS was used to overlay data layers for several steps:

- 1) The county boundaries and the land uses to get the area of each land use in each county. The number of animals was divided by the area of each land use for the county to get an animal density for each county.
- 2) The subwatershed boundaries and the land uses to get the area of each land use in each subwatershed.
- 3) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was used to determine the number of animals in the subwatershed.

Using MS Access, for each type of livestock, the animal density by county was multiplied by the area of each land use by county in each subwatershed to get the number of animals in each subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of animals in the subwatershed. The number of animals in each subwatershed was summed to get the total number of animals in each watershed.

**Pets:**

US Census Bureau data provided the number of households by county. The number of dogs per county was divided by the area of the county to get a dog density per county. GIS was used to overlay the subwatershed boundaries with the county boundaries to get the area of each county in a subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated. Using MS Access, the area of each county in the subwatershed was multiplied by the dog density per county to get the number of dogs per subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of dogs in the subwatershed. The number of dogs in each subwatershed was summed to get the total number of dogs in each watershed.

**Wildlife:**

Deer—

The number of deer were calculated using information supplied by DGIF, consisting of an average deer index by county and the formula:

$\# \text{deer}/\text{mi}^2 \text{ of deer habitat} = (-0.64 + (7.74 * \text{average deer index}))$ .

Deer habitat consists of forests, wetlands, and agricultural lands (crop and pasture). GIS was used to overlay data layers for the following steps:

- 1) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated.
- 2) The subwatershed boundaries and the deer habitat to get the area of deer habitat in each subwatershed.

Using MS Access, number of deer in each subwatershed were calculated by multiplying the  $\# \text{deer}/\text{mi}^2$  of deer habitat times the area of deer habitat. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of deer in the subwatershed. The number of deer in each subwatershed was summed to get the total number of deer in each watershed.

Ducks and Geese—

The data for ducks and geese were divided into summer (April through September) and winter (October through March).

**Summer**

The summer numbers were obtained from the Breeding Bird Population Survey (US Fish and Wildlife Service) and consisted of bird densities (ducks and geese) for 3 regions: the south side of the James

River, the rest of the tidal areas, and the salt marshes in both areas. The number of ducks and geese in the salt marshes were distributed into the other 2 regions based on the areal proportion of salt marshes in them using the National Wetland Inventory data and GIS.

#### **Winter**

The winter numbers were obtained from the Mid-Winter Waterfowl Survey (US Fish and Wildlife Service) and consisted of population numbers for ducks and geese in several different areas in the tidal region of Virginia. MS Access was used to calculate the total number of ducks and geese in each area and then these numbers were grouped to match the 2 final regions (Southside and the rest of tidal Virginia) for the summer waterfowl populations. Winter populations were an order of magnitude larger than summer populations.

Data from DGIF showed the spatial distribution of ducks and geese for 1993 and 1994. Using this information and GIS a 250m buffer on each side of the shoreline was generated and contained 80% of the birds. Wider buffers did not incorporate significantly more birds, since they were located too far inland. GIS was used to overlay the buffer and the watershed boundaries to calculate the area of buffer in each watershed. To distribute this information into each subwatershed, GIS was used to calculate the length of shoreline in each subwatershed and the total length of shoreline in the watershed. Dividing the length of shoreline in each subwatershed by the total length of shoreline gives a ratio that was multiplied by the area of the watershed to get an estimate of the area of buffer in each subwatershed. MS Excel was used to multiply the area of buffer in each subwatershed times the total numbers of ducks and geese to get the numbers of ducks and geese in each subwatershed. These numbers were summed to get the total number of ducks and geese in each watershed. To get annual populations, the totals then were divided by 2, since they represent only 6 months of habitation (this reduction underestimates the total annual input from ducks and geese, but is the easiest conservative method to use since there is not a way to incorporate the seasonal differences).

#### Raccoons—

Estimates for raccoon densities were supplied by DGIF for 3 habitats—wetlands (including freshwater and saltwater, forested and herbaceous), along streams, and upland forests. GIS was used to generate a 600ft buffer around the wetlands and streams, and then to overlay this buffer layer with the subwatershed boundaries to get the area of the buffer in each subwatershed. GIS was used to overlay the forest layer with the subwatershed boundaries to get the area of forest in each subwatershed. MS Access was used to multiply the raccoon densities for each habitat times the area of each habitat in each subwatershed to get the number of raccoons in each habitat in each subwatershed. The number of raccoons in each subwatershed was summed to get the total number of raccoons in each watershed.



### C. Watershed Source Assessment

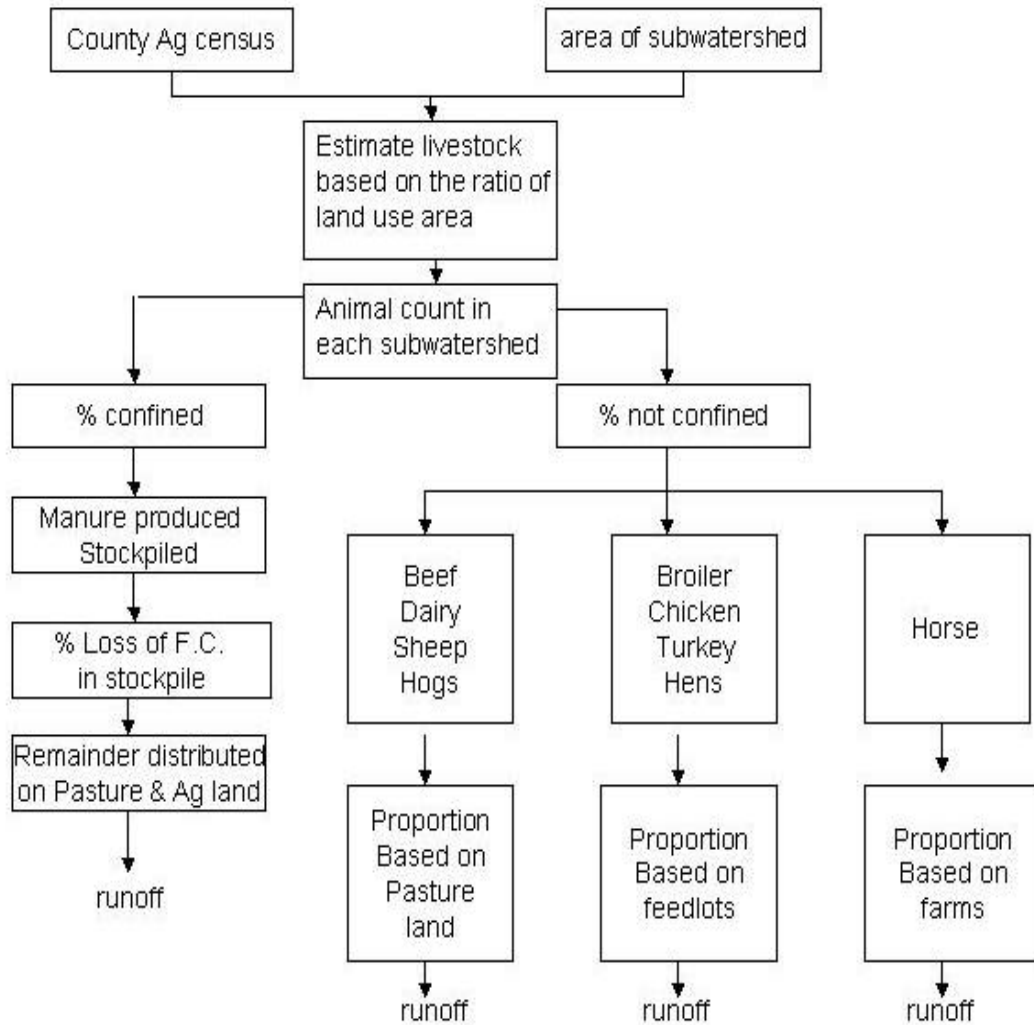
The watershed assessment calculates fecal coliform loads by source based on geographic information system data. A geographic information system is a powerful computer software package that can store large amounts of spatially referenced data and associated tabular information. The data layers produced by a GIS can be used for many different tasks, such as generating maps, analyzing results, and modeling processes. The watershed model requires a quantitative assessment of human sewage sources (i. e., malfunctioning septic systems) and animal (livestock, pets and wildlife) fecal sources distributed within each watershed.

The fecal coliform contribution from livestock is through the manure spreading processes and direct deposition during grazing. This contribution was initially estimated based on land use data and the livestock census data. In the model, manure was applied to both cropland and pasture land depending on the grazing period. Figure B-1 shows a diagram of the procedure for estimating the total number of livestock in the watershed and fecal coliform production. A description of the process used to determine the source population values for wildlife, pets and human used in the calculation of percent loading is found in Appendix B above.

**Table B-3 Nonpoint Source Load Distribution by Condemned Area Using Watershed Model: Growing Areas 16 & 17**

Condemned Area	Livestock	Wildlife	Human	Pet
016-057 Indian Creek	3%	23%	65%	9%
016-024 Dymer Creek	11%	22%	26%	41%
016-133 Tabbs Creek	12%	62%	18%	8%
017-188 Antipoison Creek	2%	30%	66%	2%

**FIGURE B.1 Diagram to Illustrate Procedure Used to Estimate Fecal Coliform Production from Estimated Livestock Population**



## Appendix C: Water Quality Data Summary

**Table C.1 Observed Geometric Mean and 90<sup>th</sup> Percentile by Condemned Area and Station for Indian Creek and Tributaries**

<b>Condemned Area</b>	<b>DSS Station Number</b>	<b>Mean of Geometric Means</b>	<b>SD Geometric Means</b>	<b>Mean of the 90<sup>th</sup> Means</b>	<b>SD 90<sup>th</sup> Means</b>	<b>Last 30 Sample Geo mean</b>	<b>Last 30 Sample 90<sup>th</sup></b>
<b>Indian Creek Main Stem</b>	16-26	3.85	0.53	9.99	6.19	2.92	13.23
	16-27	5.07	1.09	19.76	11.63	2.99	12.04
	16-28	5.59	1.14	23.10	10.11	3.91	21.87
	16-29	8.13	2.58	43.50	24.77	5.23	39.09
	16-30	12.26	4.74	96.59	85.65	7.82	46.02
	16-30A	18.02	6.76	140.45	88.32	13.99	114.37
	16-32	19.10	10.30	189.59	190.37	12.33	87.70
<b>Barnes Creek</b>	16-22_5	8.52	2.28	45.16	17.57	6.35	33.49
<b>Henrys Creek</b>	16-24	4.09	0.72	12.49	6.67	3.01	12.96
	16-25	5.82	1.70	26.71	15.66	3.56	13.61
	16-25A	9.37	1.39	42.00	10.61	8.70	46.51
	16-25B	5.90	1.34	30.73	14.11	4.49	23.50
<b>Bells Creek</b>	16-27_5	9.07	2.05	48.08	10.34	5.86	31.19
<b>Long Creek</b>	16-28_5	6.27	1.85	38.33	22.27	4.48	26.60
<b>Pitmans Cove</b>	16-29A	13.14	5.63	97.99	75.87	8.49	48.29
	16-29B	21.15	11.76	171.24	143.96	14.05	84.94
<b>Waverly Cove</b>	16-30B	20.99	10.37	187.19	185.85	10.50	68.91
<b>Arthur Cove</b>	16-29C	6.85	1.35	36.86	8.79	5.13	28.72

**Table C.2 Observed Geometric Mean and 90<sup>th</sup> Percentile by Condemned Area and Station for Dymer Creek and Tributaries**

<b>Condemned Area</b>	<b>DSS Station Number</b>	<b>Mean of Geometric Means</b>	<b>SD Geometric Means</b>	<b>Mean of the 90<sup>th</sup> Means</b>	<b>SD 90<sup>th</sup> Means</b>	<b>Last 30 Sample Geo mean</b>	<b>Last 30 Sample 90<sup>th</sup></b>
<b>Dymer Creek Main Stem</b>	16-17	4.27	0.68	10.88	4.14	2.95	8.89
	16-19	5.75	1.09	24.61	9.04	3.25	13.28
	16-20	8.40	2.28	40.08	20.22	5.29	23.16
	16-21	16.64	5.37	107.25	58.80	11.24	86.49
	16-21A	27.57	12.36	203.48	127.11	16.06	88.88
<b>Ashley Cove</b>	16-16	5.95	1.81	25.77	16.42	4.05	21.45
	16-16_5	4.36	0.82	22.23	6.61	3.46	18.95
<b>Lees Cove</b>	16-17A	12.00	1.94	72.04	18.34	8.11	53.51
<b>Rones Bay</b>	16-17B	3.39	0.42	9.00	1.30	2.78	8.37
<b>Hunts Cove</b>	16-18	7.47	2.30	36.35	19.85	5.05	21.16
<b>Georges Cove</b>	16-19A	6.77	1.72	36.72	27.41	4.43	30.21
	16-19B	8.77	2.19	51.68	23.16	4.51	25.49
<b>Poplar Neck Creek</b>	16-19C	6.17	1.28	26.55	9.96	4.32	23.74
<b>Johnsons Cove</b>	16-19_1	9.82	5.07	69.40	78.68	7.29	51.87
<b>Un-named Cove</b>	16-20A	12.17	4.66	87.35	57.13	8.13	55.47
<b>Chases Cove</b>	16-20B	12.48	3.25	88.87	39.69	9.63	67.37

Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL  
**Table C.3 Observed Geometric Mean and 90<sup>th</sup> Percentile by Condemned Area and Station for  
 Tabbs Creek**

<b>Condemned Area</b>	<b>DSS Station Number</b>	<b>Mean of Geometric Means</b>	<b>SD Geometric Means</b>	<b>Mean of the 90<sup>th</sup> Means</b>	<b>SD 90<sup>th</sup> Means</b>	<b>Last 30 Sample Geo mean</b>	<b>Last 30 Sample 90th</b>
<b>Tabbs Creek</b>	16-10	5.49	1.38	20.56	11.08	3.77	18.20
	16-10_5	6.43	1.16	32.72	6.52	5.18	27.46
	16-11	7.47	2.62	36.14	16.25	4.95	32.44
	16-12	12.71	6.52	83.79	72.93	8.49	41.44
	16-12_5	10.61	3.74	75.73	40.96	7.08	45.61
	16-13	20.11	10.12	146.85	113.80	7.19	39.22
	16-13_5	41.62	27.69	326.55	210.64	31.59	167.74



Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL  
**Table C.4 Observed Geometric Mean and 90<sup>th</sup> Percentile by Condemned Area and Station for Antipoison Creek**

<b>Condemned Area</b>	<b>DSS Station Number</b>	<b>Mean of Geometric Means</b>	<b>SD Geometric Means</b>	<b>Mean of the 90<sup>th</sup> Means</b>	<b>SD 90<sup>th</sup> Means</b>	<b>Last 30 Sample Geo mean</b>	<b>Last 30 Sample 90<sup>th</sup></b>
<b>Antipoison Creek</b>	17-3	3.28	0.24	5.35	1.80	2.88	8.25
	17-4	5.30	2.24	23.45	22.79	3.64	16.56
	17-5	5.31	1.23	20.54	11.26	3.78	15.69
	17-6	7.32	2.14	36.80	20.04	3.95	17.77
	17-7	8.77	2.65	41.35	17.33	5.22	26.13
	17-8	12.01	4.01	71.04	33.15	6.87	37.58
<b>Un-named Cove to Antipoison North</b>	17-5A	7.94	1.40	39.66	12.09	7.01	36.44
	17-5B	13.22	1.84	79.68	13.91	12.59	78.00
<b>Un-named Cove to Antipoison South</b>	17-5C	10.00	2.12	58.89	9.26	7.47	49.38
<b>Davenport Creek</b>	17-4A	18.33	5.58	176.63	65.44	10.32	86.37
<b>Harpers Creek (tributary to Antipoison Creek)</b>	17-6_5	7.18	1.72	47.71	15.05	5.01	31.97

## **Appendix D**

### **1) Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.**

### **2) Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000**

#### **D1: Code of Virginia §62.1-194.1**

##### **§62.1-194.1. Obstructing or contaminating state waters .**

Except as otherwise permitted by law, it shall be unlawful for any person to dump, place or put, or cause to be dumped, placed or put into, upon the banks of or into the channels of any state waters any object or substance, noxious or otherwise, which may reasonably be expected to endanger, obstruct, impede, contaminate or substantially impair the lawful use or enjoyment of such waters and their environs by others. Any person who violates any provision of this law shall be guilty of a misdemeanor and upon conviction be punished by a fine of not less than \$100 nor more than \$500 or by confinement in jail not more than twelve months or both such fine and imprisonment. Each day that any of said materials or substances so dumped, placed or put, or caused to be dumped, placed or put into, upon the banks of or into the channels of, said streams shall constitute a separate offense and be punished as such. In addition to the foregoing penalties for violation of this law, the judge of the circuit court of the county or corporation court of the city wherein any such violation occurs, whether there be a criminal conviction therefore or not shall, upon a bill in equity, filed by the attorney for the Commonwealth of such county or by any person whose property is damaged or whose property is threatened with damage from any such violation, award an injunction enjoining any violation of this law by any person found by the court in such suit to have violated this law or causing the same to be violated, when made a party defendant to such suit. (1968, c. 659.)

#### **D2: Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000 From the U.S. Government Printing Office via GPO Access [CITE: 33CFR159]**

##### **NAVIGABLE WATERS**

##### **CHAPTER I-COAST GUARD, DEPARTMENT OF TRANSPORTATION (CONTINUED)**

##### **PART 159--MARINE SANITATION DEVICES**

##### **Subpart A--General**

Sec.

159.1 Purpose.

159.3 Definitions.

159.4 Incorporation by reference.

159.5 Requirements for vessel manufacturers.

159.7 Requirements for vessel operators.

**Subpart B -- Certification Procedures**

- 159.11 Purpose.
- 159.12 Regulations for certification of existing devices.
- 159.12a Certification of certain Type III devices.
- 159.14 Application for certification.
- 159.15 Certification.
- 159.16 Authorization to label devices.
- 159.17 Changes to certified devices.
- 159.19 Testing equivalency.

**Subpart C -- Design, Construction, and Testing**

- 159.51 Purpose and scope.
- 159.53 General requirements.
- 159.55 Identification.
- 159.57 Installation, operation, and maintenance instructions.
- 159.59 Placard.
- 159.61 Vents.
- 159.63 Access to parts.
- 159.65 Chemical level indicator.
- 159.67 Electrical component ratings.
- 159.69 Motor ratings.
- 159.71 Electrical controls and conductors.
- 159.73 Conductors.
- 159.75 Overcurrent protection.
- 159.79 Terminals.
- 159.81 Baffles.
- 159.83 Level indicator.
- 159.85 Sewage removal.
- 159.87 Removal fittings.
- 159.89 Power interruption: Type I and II devices.
- 159.93 Independent supporting.

- 159.95 Safety.
- 159.97 Safety: inspected vessels.
- 159.101 Testing: general.
- 159.103 Vibration test.
- 159.105 Shock test.
- 159.107 Rolling test.
- 159.109 Pressure test.
- 159.111 Pressure and vacuum pulse test.
- 159.115 Temperature range test.
- 159.117 Chemical resistance test.
- 159.119 Operability test; temperature range.
- 159.121 Sewage processing test.
- 159.123 Coliform test: Type I devices.
- 159.125 Visible floating solids: Type I devices.
- 159.126 Coliform test: Type II devices.
- 159.126a Suspended solids test: Type II devices.
- 159.127 Safety coliform count: Recirculating devices.
- 159.129 Safety: Ignition prevention test.
- 159.131 Safety: Incinerating device.

#### **Subpart D--Recognition of Facilities**

- 159.201 Recognition of facilities.

Authority: Sec. 312(b)(1), 86 Stat. 871 (33 U.S.C. 1322(b)(1)); 49 CFR 1.45(b) and 1.46(l) and (m).

Source: CGD 73-83, 40 FR 4624, Jan. 30, 1975, unless otherwise noted.

#### **Subpart A--General**

##### **Sec. 159.1 Purpose.**

This part prescribes regulations governing the design and construction of marine sanitation devices and procedures for certifying that marine sanitation devices meet the regulations and the standards of the Environmental Protection Agency promulgated under section 312 of the Federal Water Pollution Control Act (33 U.S.C. 1322), to eliminate the discharge of untreated sewage from vessels into the waters of the United States, including the territorial seas. Subpart A of this part contains regulations governing the manufacture and operation of vessels equipped with marine sanitation devices.

##### **Sec. 159.3 Definitions.**

In this part:

**Coast Guard** means the Commandant or his authorized representative.

**Discharge** includes, but is not limited to, any spilling, leaking, pouring, pumping, emitting, emptying, or dumping.

**Existing vessel** includes any vessel, the construction of which was initiated before January 30, 1975.

**Fecal coliform bacteria** are those organisms associated with the intestine of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.

**Inspected vessel** means any vessel that is required to be inspected under 46 CFR Ch. I.

**Length** means a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments are not to be included in the measurement.

**Manufacturer** means any person engaged in manufacturing, assembling, or importing of marine sanitation devices or of vessels subject to the standards and regulations promulgated under section 312 of the Federal Water Pollution Control Act.

**Marine sanitation device and device** includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.

**New vessel** includes any vessel, the construction of which is initiated on or after January 30, 1975.

**Person** means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel.

## Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

**Public vessel** means a vessel owned or bare-boat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.

**Recognized facility** means any laboratory or facility listed by the Coast Guard as a recognized facility under this part.

**Sewage** means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body waste.

**Territorial seas** means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of 3 miles.

**Type I marine sanitation device** means a device that, under the test conditions described in Secs. 159.123 and 159.125, produces an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids.

**Type II marine sanitation device** means a device that, under the test conditions described in Secs. 159.126 and 159.126a, produces an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.

**Type III marine sanitation device** means a device that is designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage.

**Uninspected vessel** means any vessel that is not required to be inspected under 46 CFR Chapter I.

**United States** includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands.

**Vessel** includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the waters of the United States.

[CGD 96-026, 61 FR 33668, June 28, 1996, as amended by CGD 95-028, 62 FR 51194, Sept. 30, 1997]

### Sec. 159.4 Incorporation by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in paragraph (b) of this section, the Coast Guard must publish notice of change in the Federal Register; and the material must be available to the public. All approved material is available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC, and at the U.S. Coast Guard Office of Design and Engineering Standards (G-MSE), 2100 Second Street SW., Washington, DC 20593-0001, and is available from the sources indicated in paragraph (b) of this section.

(b) The material approved for incorporation by reference in this part, and the sections affected, are as follows:

American Society for Testing and Materials (ASTM)  
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 11-95, Standard Specification for Wire Cloth and Sieves for Testing Purposes--159.125

[USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

### Sec. 159.5 Requirements for vessel manufacturers.

No manufacturer may manufacture for sale, sell, offer for sale, or distribute for sale or resale any vessel equipped with installed toilet facilities unless it is equipped with:

(a) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(b) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

[CGD 95-028, 62 FR 51194, Sept. 30, 1997]

### Sec. 159.7 Requirements for vessel operators.

(a) No person may operate any vessel equipped with installed toilet facilities unless it is equipped with:



## Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

(1) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(2) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

(b) When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3 or 140.4, the operator must secure each Type I or Type II device in a manner which prevents discharge of treated or untreated sewage. Acceptable methods of securing the device include--

- (1) Closing the seacock and removing the handle;
- (2) Padlocking the seacock in the closed position;
- (3) Using a non-releasable wire-tie to hold the seacock in the closed position; or
- (4) Locking the door to the space enclosing the toilets with a padlock or door handle key lock.

(c) When operating a vessel on a body of water where the discharge of untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3, the operator must secure each Type III device in a manner which prevents discharge of sewage. Acceptable methods of securing the device include--

- (1) Closing each valve leading to an overboard discharge and removing the handle;
- (2) Padlocking each valve leading to an overboard discharge in the closed position; or
- (3) Using a non-releasable wire-tie to hold each valve leading to an overboard discharge in the closed position.

[CGH 95-028, 62 FR 51194, Sept. 30, 1997]

### Subpart B -- Certification Procedures

#### Sec. 159.11 Purpose.

This subpart prescribes procedures for certification of marine sanitation devices and authorization for labels on certified devices.

#### Sec. 159.12 Regulations for certification of existing devices.

(a) The purpose of this section is to provide regulations for certification of existing devices until manufacturers can design and manufacture devices that comply with this part and recognized facilities are prepared to perform the testing required by this part.

(b) Any Type III device that was installed on an existing vessel before January 30, 1975, is considered certified.

(c) Any person may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 for certification of a marine sanitation device manufactured before January 30, 1976. The Coast Guard will issue a letter certifying the device if the applicant shows that the device meets Sec. 159.53 by:

- (1) Evidence that the device meets State standards at least equal to the standards in Sec. 159.53, or
  - (2) Test conducted under this part by a recognized laboratory, or
  - (3) Evidence that the device is substantially equivalent to a device certified under this section, or
  - (4) A Coast Guard field test if considered necessary by the Coast Guard.
- (d) The Coast Guard will maintain and make available a list that identifies each device certified under this section.

(e) Devices certified under this section in compliance with Sec. 159.53 need not meet the other regulations in this part and may not be labeled under Sec. 159.16.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

#### Sec. 159.12a Certification of certain Type III devices.

(a) The purpose of this section is to provide regulations for certification of certain Type III devices.

(b) Any Type III device is considered certified under this section if:

- (1) It is used solely for the storage of sewage and flushwater at ambient air pressure and temperature; and
- (2) It is in compliance with Sec. 159.53(c).

(c) Any device certified under this section need not comply with the other regulations in this part except as required in paragraphs (b)(2) and (d) of this section and may not be labeled under Sec. 159.16.

(d) Each device certified under this section which is installed aboard an inspected vessel must comply with Sec. 159.97.

[CGD 76-145, 42 FR 11, Jan. 3, 1977]

Sec. 159.14 Application for certification.

(a) Any manufacturer may apply to any recognized facility for certification of a marine sanitation device. The application for certification must indicate whether the device will be used aboard all vessels or only aboard uninspected vessels and to which standard in Sec. 159.53 the manufacturer requests the device to be tested.

(b) An application may be in any format but must be in writing and must be signed by an authorized representative of the manufacturer and include or be accompanied by:

(1) A complete description of the manufacturer's production quality control and inspection methods, record keeping systems pertaining to the manufacture of marine sanitation devices, and testing procedures;

(2) The design for the device, including drawings, specifications and other information that describes the materials, construction and operation of the device;

(3) The installation, operation, and maintenance instructions for the device; and

(4) The name and address of the applicant and the manufacturing facility.

(c) The manufacturer must furnish the recognized facility one device of each model for which certification is requested and samples of each material from which the device is constructed, that must be tested destructively under Sec. 159.117. The device furnished is for the testing required by this part except that, for devices that are not suited for unit testing, the manufacturer may submit the design so that the recognized facility may determine the components of the device and materials to be submitted for testing and the tests to be performed at a place other than the facility. The Coast Guard must review and accept all such determinations before testing is begun.

(d) At the time of submittal of an application to a recognized facility the manufacturer must notify the Coast Guard of the type and model of the device, the name of the recognized facility to which application is being made, and the name and address of the manufacturer, and submit a signed statement of the times when the manufacturer will permit designated officers and employees of the Coast Guard to have access to the manufacturer's facilities and all records required by this part.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.15 Certification.

(a) The recognized facility must evaluate the information that is submitted by the manufacturer in accordance with Sec. 159.14(b) (1), (2), and (3), evaluate the device for compliance with Secs. 159.53 through 159.95, test the device in accordance with Sec. 159.101 and submit to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 the following:

(1) The information that is required under Sec. 159.14(b);

(2) A report on compliance evaluation;

(3) A description of each test;

(4) Test results; and

(5) A statement, that is signed by the person in charge of testing, that the test results are accurate and complete.

(b) The Coast Guard certifies a test device, on the design of the device, if it determines, after consideration of the information that is required under paragraph (a) of this section, that the device meets the requirements in Subpart C of this part.

(c) The Coast Guard notifies the manufacturer and recognized facility of its determination under paragraph (b) of this section. If the device is certified, the Coast Guard includes a certification number for the device. If certification is denied, the Coast Guard notifies the manufacturer and recognized facility of the requirements of this part that are not met. The manufacturer may appeal a denial to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

(d) If upon re-examination of the test device, the Coast Guard determines that the device does not in fact comply with the requirements of Subpart C of this part, it may terminate the certification.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

## Indian, Dymer, Tabbs and Antipoison Creeks Shellfish TMDL

### Sec. 159.16 Authorization to label devices.

(a) When a test device is certified under Sec. 159.15(b), the Coast Guard will issue a letter that authorizes the manufacturer to label each device that he manufactures with the manufacturer's certification that the device is in all material respects substantially the same as a test device certified by the U.S. Coast Guard pursuant to section 312 of the Federal Water Pollution Control Act Amendments of 1972.

(b) Certification placed on a device by its manufacturer under this section is the certification required by section 312(h)(4) of the Federal Water Pollution Control Act Amendments of 1972, which makes it unlawful for a vessel that is subject to the standards and regulations promulgated under the Act to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to section 312 of the Act.

(c) Letters of authorization issued under this section are valid for 5 years, unless sooner suspended, withdrawn, or terminated and may be reissued upon written request of the manufacturer to whom the letter was issued.

(d) The Coast Guard, in accordance with the procedure in 46 CFR 2.75, may suspend, withdraw, or terminate any letter of authorization issued under this section if the Coast Guard finds that the manufacturer is engaged in the manufacture of devices labeled under this part that are not in all material respects substantially the same as a test device certified pursuant to this part.

### Sec. 159.17 Changes to certified devices.

(a) The manufacturer of a device that is certified under this part shall notify the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 in writing of any change in the design of the device.

(b) A manufacturer shall include with a notice under paragraph (a) of this section a description of the change, its advantages, and the recommendation of the recognized facility as to whether the device remains in all material respects substantially the same as the original test device.

(c) After notice under paragraph (a) of this section, the Coast Guard notifies the manufacturer and the recognized facility in writing of any tests that must be made for certification of the device or for any change in the letter of authorization. The manufacturer may appeal this determination to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

### Sec. 159.19 Testing equivalency.

(a) If a test required by this part may not be practicable or necessary, a manufacturer may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, DC 20593-0001 for deletion or approval of an alternative test as equivalent to the test requirements in this part. The application must include the manufacturer's justification for deletion or the alternative test and any alternative test data.

(b) The Coast Guard notifies the manufacturer of its determination under paragraph (a) of this section and that determination is final.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

## **Subpart C--Design, Construction, and Testing**

### Sec. 159.51 Purpose and scope.

(a) This subpart prescribes regulations governing the design and construction of marine sanitation devices.

(b) Unless otherwise authorized by the Coast Guard each device for which certification under this part is requested must meet the requirements of this subpart.

## Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

### Sec. 159.53 General requirements.

A device must:

- (a) Under the test conditions described in Secs. 159.123 and 159.125, produce an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids (Type I),
- (b) Under the test conditions described in Secs. 159.126 and 159.126a, produce an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter (Type II), or
- (c) Be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage (Type III).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

### Sec. 159.55 Identification.

(a) Each production device must be legibly marked in accordance with paragraph (b) of this section with the following information:

- (1) The name of the manufacturer.
- (2) The name and model number of the device.
- (3) The month and year of completion of manufacture.
- (4) Serial number.
- (5) Whether the device is certified for use on an inspected or an uninspected vessel.
- (6) Whether the device is Type I, II, or III.

(b) The information required by paragraph (a) of this section must appear on a nameplate attached to the device or in lettering on the device. The nameplate or lettering stamped on the device must be capable of withstanding without loss of legibility the combined effects of normal wear and tear and exposure to water, salt spray, direct sunlight, heat, cold, and any substance listed in Sec. 159.117(b) and (c). The nameplate and lettering must be designed to resist efforts to remove them from the device or efforts to alter the information stamped on the nameplate or the device without leaving some obvious evidence of the attempted removal or alteration.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

### Sec. 159.57 Installation, operation, and maintenance instructions.

(a) The instructions supplied by the manufacturer must contain directions for each of the following:

- (1) Installation of the device in a manner that will permit ready access to all parts of the device requiring routine service and that will provide any flue clearance necessary for fire safety.
- (2) Safe operation and servicing of the device so that any discharge meets the applicable requirements of Sec. 159.53.
- (3) Cleaning, winter layup, and ash or sludge removal.
- (4) Installation of a vent or flue pipe.
- (5) The type and quantity of chemicals that are required to operate the device, including instructions on the proper handling, storage and use of these chemicals.
- (6) Recommended methods of making required plumbing and electrical connections including fuel connections and supply circuit overcurrent protection.

(b) The instructions supplied by the manufacturer must include the following information:

- (1) The name of the manufacturer.
- (2) The name and model number of the device.
- (3) Whether the device is certified for use on an inspected, or uninspected vessel.
- (4) A complete parts list.
- (5) A schematic diagram showing the relative location of each part.
- (6) A wiring diagram.
- (7) A description of the service that may be performed by the user without coming into contact with sewage or chemicals.
- (8) Average and peak capacity of the device for the flow rate, volume, or number of persons that the device is capable of serving and the period of time the device is rated to operate at peak capacity.

## Indian, Dymmer, Tabbs and Antipoison Creeks Shellfish TMDL

- (9) The power requirements, including voltage and current.
- (10) The type and quantity of fuel required.
- (11) The duration of the operating cycle for unitized incinerating devices.
- (12) The maximum angles of pitch and roll at which the device operates in accordance with the applicable requirements of Sec. 159.53.
- (13) Whether the device is designed to operate in salt, fresh, or brackish water.
- (14) The maximum hydrostatic pressure at which a pressurized sewage retention tank meets the requirements of Sec. 159.111.
- (15) The maximum operating level of liquid retention components.
- (16) Whether the device is Type I, II, or III.
- (17) A statement as follows:

Note: The EPA standards state that in freshwater lakes, freshwater reservoirs or other freshwater impoundments whose inlets or outlets are such as to prevent the ingress or egress by vessel traffic subject to this regulation, or in rivers not capable of navigation by interstate vessel traffic subject to this regulation, marine sanitation devices certified by the U.S. Coast Guard installed on all vessels shall be designed and operated to prevent the overboard discharge of sewage, treated or untreated, or of any waste derived from sewage. The EPA standards further state that this shall not be construed to prohibit the carriage of Coast Guard-certified flow-through treatment devices which have been secured so as to prevent such discharges. They also state that waters where a Coast Guard-certified marine sanitation device permitting discharge is allowed include coastal waters and estuaries, the Great Lakes and interconnected waterways, freshwater lakes and impoundments accessible through locks, and other flowing waters that are navigable interstate by vessels subject to this regulation (40 CFR 140.3).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

### Sec. 159.59 Placard.

Each device must have a placard suitable for posting on which is printed the operating instructions, safety precautions, and warnings pertinent to the device. The size of the letters printed on the placard must be one-eighth of an inch or larger.

### Sec. 159.61 Vents.

Vents must be designed and constructed to minimize clogging by either the contents of the tank or climatic conditions such as snow or ice.

### Sec. 159.63 Access to parts.

Each part of the device that is required by the manufacturer's instructions to be serviced routinely must be readily accessible in the installed position of the device recommended by the manufacturer.

### Sec. 159.65 Chemical level indicator.

The device must be equipped with one of the following:

- (a) A means of indicating the amount in the device of any chemical that is necessary for its effective operation.
- (b) A means of indicating when chemicals must be added for the proper continued operation of the device.

### Sec. 159.67 Electrical component ratings.

Electrical components must have current and voltage ratings equal to or greater than the maximum load they may carry.

### Sec. 159.69 Motor ratings.

Motors must be rated to operate at 50 deg.C ambient temperature.

### Sec. 159.71 Electrical controls and conductors.

Electrical controls and conductors must be installed in accordance with good marine practice. Wire must be copper and must be stranded. Electrical controls and conductors must be protected from exposure to chemicals and sewage.



Sec. 159.73 Conductors.

Current carrying conductors must be electrically insulated from non-current carrying metal parts.

Sec. 159.75 Overcurrent protection.

Overcurrent protection must be provided within the unit to protect subcomponents of the device if the manufacturer's recommended supply circuit overcurrent protection is not adequate for these subcomponents.

Sec. 159.79 Terminals.

Terminals must be solderless lugs with ring type or captive spade ends, must have provisions for being locked against movement from vibration, and must be marked for identification on the wiring diagram required in Sec. 159.57. Terminal blocks must be nonabsorbent and securely mounted. Terminal blocks must be provided with barrier insulation that prevents contact between adjacent terminals or metal surfaces.

Sec. 159.81 Baffles.

Baffles in sewage retention tanks, if any, must have openings to allow liquid and vapor to flow freely across the top and bottom of the tank.

Sec. 159.83 Level indicator.

Each sewage retention device must have a means of indicating when the device is more than  $\frac{3}{4}$  full by volume.

Sec. 159.85 Sewage removal.

The device must be designed for efficient removal of nearly all of the liquid and solids in the sewage retention tank.

Sec. 159.87 Removal fittings.

If sewage removal fittings or adapters are provided with the device, they must be of either 1½" or 4" nominal pipe size.

Sec. 159.89 Power interruption: Type I and II devices.

A discharge device must be designed so that a momentary loss of power during operation of the device does not allow a discharge that does not meet the requirements in Sec. 159.53.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.93 Independent supporting.

The device must have provisions for supporting that are independent from connecting pipes.

Sec. 159.95 Safety.

(a) Each device must--

(1) Be free of design defects such as rough or sharp edges that may cause bodily injuries or that would allow toxic substances to escape to the interior of the vessel;

(2) Be vented or provided with a means to prevent an explosion or over pressurization as a result of an accumulation of gases; and

(3) Meet all other safety requirements of the regulations applicable to the type of vessel for which it is certified.

(b) A chemical that is specified or provided by the manufacturer for use in the operation of a device and is defined as a hazardous material in 46 CFR Part 146 must be certified by the procedures in 46 CFR Part 147.

## Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

(c) Current carrying components must be protected from accidental contact by personnel operating or routinely servicing the device. All current carrying components must as a minimum be of drip-proof construction or be enclosed within a drip-proof compartment.

Sec. 159.97 Safety: inspected vessels.

The Commandant approves the design and construction of devices to be certified for installation and operation on board inspected vessels on the basis of tests and reports of inspection under the applicable marine engineering requirements in Subchapter F of Title 46, Code of Federal Regulations, and under the applicable electrical engineering requirements in Subchapter J of Title 46 Code of Federal Regulations.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.101 Testing: general.

Unless otherwise authorized by the Coast Guard, a recognized facility must perform each test described in Secs. 159.103 through 159.131. The same device must be used for each test and tested in the order in which the tests are described. There must be no cracking, softening, deterioration, displacement, breakage, leakage or damage of components or materials that affects the operation or safety of the device after each test described in Secs. 159.103 through 159.117 and Sec. 159.121, and the device must remain operable after the test described in Sec. 159.119. The device must be set up in a manner simulating installation on a vessel in accordance with the manufacturer's instructions with respect to mounting, water supply, and discharge fittings.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.103 Vibration test.

The device, with liquid retention components, if any, filled with water to one-half of their volume, must be subjected to a sinusoidal vibration for a period of 12 hours, 4 hours in each of the x, y, and z planes, at the resonant frequency of the device (or at 55 cycles per second if there is no resonant frequency between 10 to 60 hertz) and with a peak amplitude of 0.019 to 0.021 inches.

Sec. 159.105 Shock test.

The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 1,000 vertical shocks that are ten times the force of gravity (10g) and have a duration of 20-25 milliseconds measured at the base of the half-sine shock envelope.

Sec. 159.107 Rolling test.

(a) The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 100 cycles with the axis of rotation 4 feet from the centerline of the device, no more than 6 inches below the plane of the bottom of the device, and parallel to any tank baffles. The device must then be rotated 90 degrees on its vertical axis and subjected to another 100 cycles. This testing must be repeated with the liquid retention components filled to the maximum operating level as specified by the manufacturer in Sec. 159.57.

(b) Eighty percent of the rolling action must be approximately 15 degrees on either side of the vertical and at a cyclic rate of 3 to 4 seconds. Twenty percent motions must be approximately 30 degrees, or the maximum angle specified by the manufacturer under Sec. 159.57, whichever is greater, on either side of the vertical at a cyclic rate of 6 to 8 seconds.

Sec. 159.109 Pressure test.

Any sewage retention tank that is designed to operate under pressure must be pressurized hydrostatically at a pressure head of 7 feet or to 150 percent of the maximum pressure specified by the manufacturer for operation of the tank, whichever is greater. The tank must hold the water at this pressure for 1 hour with no evidence of leaking.

Sec. 159.111 Pressure and vacuum pulse test.

Liquid retention components of the device with manufacturer specified venting installed must be subjected to 50 fillings of water at a pressure head of 7 feet or the maximum pressure specified by the manufacturer for operation of the device, whichever is greater, and then emptied with a 45 gallon per minute or larger positive displacement pump that remains in operation 30 seconds after emptying the tank at the end of each cycle.

Sec. 159.115 Temperature range test.

- (a) The device must be held at a temperature of 60 deg.C or higher for a period of 16 hours.
- (b) The device must be held at a temperature of -40 deg.C or less for a period of 16 hours following winterization in accordance with manufacturers' instructions.

Sec. 159.117 Chemical resistance test.

- (a) In each case where the recognized facility doubts the ability of a material to withstand exposure to the substances listed in paragraphs (b) and (c) of this section a sample of the material must be tested.
- (b) A sample referred to in paragraph (a) of this section must be partially submerged in each of the following substances for 100 hours at an ambient temperature of 22 deg.C.
  - (1) Sewage.
  - (2) Any disinfectant that is required in the operation of the device.
  - (3) Any chemical compound in solid, liquid or gaseous form, used, emitted or produced in the operation of the device.
  - (4) Fresh or salt (3.5 percent Sodium Chloride) flush water.
  - (5) Toilet bowl cleaners.
  - (6) Engine Oil (SAE/30).
  - (7) Ethylene Glycol.
  - (8) Detergents (household and bilge cleaning type).
- (c) A sample of the material must be doused 20 times, with a 1 hour drying period between dousings, in each of the following substances:
  - (1) Gasoline.
  - (2) Diesel fuel.
  - (3) Mineral spirits.
  - (4) Turpentine.
  - (5) Methyl alcohol.

Sec. 159.119 Operability test; temperature range.

The device must operate in an ambient temperature of 5 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C and in an ambient temperature of 50 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C.

Sec. 159.121 Sewage processing test.

- (a) The device must process human sewage in the manner for which it is designed when tested in accordance with this section. There must be no sewage or sewage-treating chemicals remaining on surfaces or in crevices that could come in contact with a person using the device or servicing the device in accordance with the instructions supplied under Sec. 159.57(b)(7).
- (b) During the test the device must be operated and maintained in accordance with the manufacturer's instructions. Any initial start-up time specified by the manufacturer must be allowed before test periods begin. For 1 hour of each 8-hour test period, the device must be tilted to the maximum angles specified by the manufacturer under Secs. 159.55 and 159.57.
- (c) Except for devices described in paragraph (d) of this section, the devices must process and discharge or store human sewage over at least an 8-consecutive hour period on at least 10 days within a 20-day period. The device must receive human sewage consisting of fecal matter, urine, and toilet paper in a ratio of four urinations to one defecation with at least one defecation per person per day. Devices must be tested at their average rate of capacity as specified in Sec. 159.57. In addition, during three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity.

## Indian, Dyer, Tabbs and Antipoison Creeks Shellfish TMDL

(d) A device that processes and discharges continuously between individual use periods or a large device, as determined by the Coast Guard, must process and discharge sewage over at least 10-consecutive days at the average daily capacity specified by the manufacturer. During three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity. The sewage for this test must be fresh, domestic sewage to which primary sludge has been added, as necessary, to create a test sewage with a minimum of 500 milligrams of suspended solids per liter.

### Sec. 159.123 Coliform test: Type I devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent discharged from a Type I device during the test described in Sec. 159.121 must be less than 1000 per 100 milliliters when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10-test days, one sample must be taken at the beginning, middle, and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

### Sec. 159.125 Visible floating solids: Type I devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples of approximately 1 liter each shall be taken from a Type I device at the same time as samples taken in Sec. 159.123 and passed expeditiously through a U.S. Sieve No. 12 as specified in ASTM E 11 (incorporated by reference, see Sec. 159.4). The weight of the material retained on the screen after it has been dried to a constant weight in an oven at 103 deg.C. must be divided by the volume of the sample and expressed as milligrams per liter. This value must be 10 percent or less of the total suspended solids as determined in accordance with 40 CFR Part 136 or at least 38 of the 40 samples.

Note: 33 U.S.C. 1321(b)(3) prohibits discharge of harmful quantities of oil into or upon the navigable waters of the United States or adjoining shorelines or into or upon the waters of the contiguous zone. Under 40 CFR 110.3 and 110.4 such discharges of oil include discharges which:

(a) Violate applicable water quality standards, or

(b) Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If a sample contains a quantity of oil determined to be harmful, the Coast Guard will not certify the device.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

### Sec. 159.126 Coliform test: Type II devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent from a Type II device during the test described in Sec. 159.121 must be 200 per 100 milliliters or less when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10 test days, one sample must be taken at the beginning, middle and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

### Sec. 159.126a Suspended solids test: Type II devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples must be taken at the same time as samples are taken for Sec. 159.126 and they must be analyzed for total suspended solids in accordance with 40 CFR Part 136. The arithmetic mean of the total suspended solids in 38 of 40 of these samples must be less than or equal to 150 milligrams per liter.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.127 Safety coliform count: Recirculating devices.

Thirty-eight of forty samples of flush fluid from a re-circulating device must have less than 240 fecal coliform bacteria per 100 milliliters. These samples must be collected in accordance with Sec. 159.123(b) and tested in accordance with 40 CFR Part 136.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.129 Safety: Ignition prevention test.

(a) Components of a device that are a potential ignition source in an explosive atmosphere must pass the test in paragraph (b) or (c) of this section or meet the requirements of paragraph (d) or have a specific warning in the instruction manual required by Sec. 159.57 that the device should not be installed in an explosive atmosphere.

(b) Components protected by vapor exclusion must be placed in a chamber filled with a rich mixture of gasoline or propane in air with the pressure being varied from 0 to 2 psig once an hour for 8 hours. Vapor readings must be taken in the void being protected and must indicate a leakage less than 20 percent of the lower explosive limit of the mixture in the chamber.

(c) Components providing ignition protection by means other than vapor exclusion must be fitted with an ignition source, such as a spark plug, and a means of injecting an explosive mixture of gasoline or propane and air into the void that protects the component. Connections must be made so as to minimize any additional volume added to the protected void by the apparatus delivering the explosive mixture. The component must be placed in a chamber filled with an explosive mixture and there must be no ignition of the explosive mixture surrounding the component when the following tests are conducted:

(1) Using any overload protection that is part of the device, the potential ignition source must be operated for one half hour at 110 percent of its rated voltage, one half hour at 50 percent of its rated voltage and one half hour at 100 percent of its rated voltage with the motor or armature locked, if the potential ignition source is a motor or part of a motor's electrical circuit.

(2) With the explosive mixture in the protected void, the test installed ignition source must be activated 50 times.

(3) The tests paragraphs (c) (1) and (2) of this section must be repeated with any plugs removed.

(d) Components that are certified as being intrinsically safe in accordance with the Instrument Society of America (RP 12.2) or explosion proof in accordance with the Underwriters Laboratories STD 698 in Class I, Group D hazardous locations (46 CFR 111.80-5(a)) need not be subjected to this testing.

Sec. 159.131 Safety: Incinerating device.

An incinerating device must not incinerate unless the combustion chamber is closed, must purge the combustion chamber of combustible fuel vapors before and after incineration must secure automatically if the burner does not ignite, must not allow an accumulation of fuel, and must neither produce a temperature on surfaces adjacent to the incineration chamber higher than 67 deg.C nor produce a temperature on surfaces in normal body contact higher than 41 deg.C when operating in an ambient temperature of 25 deg.C. Unitized incineration devices must completely burn to a dry, inert ash, a simultaneous defecation and urination and must not discharge fly ash, malodors, or toxic substances.

#### **Subpart D--Recognition of Facilities**

Sec. 159.201 Recognition of facilities.

A recognized facility is an independent laboratory accepted by the Coast Guard under 46 CFR 159.010 to perform the tests and inspections required under this part. A list of accepted laboratories is available from the Commandant (G-MSE-3).

[CGD 95-028, 62 FR 51194, Sept. 30, 1997, as amended by USCG-1999-5832, 64 FR 34715, June 29, 1999]



## **Appendix E: Public Comments**